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Reference

FM 1-40

FIELD MANUAL

HELICOPTER GUNNERY

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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HEADQUARTERS
DEPARTMENT OF THE ARMY
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HELICOPTER GUNNERY

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PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Purpose and Scope

a. This manual explains helicopter gunnery, including practical applications of the science of ballistics and other procedures essential for the timely and accurate delivery of direct aerial fires by attack helicopters. It also provides recommended procedures for gunnery training with each helicopter armament subsystem.

b. It is a guide for helicopter unit personnel, aviation staff officers, aviation training officers, and commanders of supported tactical units. It does not cover all helicopter gunnery situations. Local modifications of the methods and techniques described herein may be necessary but should be made only when based upon firsthand knowledge and experience of the commander as measured against the state of training of his personnel.

c. The scope of this manual includes—

(1) Characteristics and capabilities of weapons and ammunition.

(2) Fundamentals of ballistics.

(3) Helicopter gunnery problems.

(4) Techniques of fire.

(5) Fire control.

(6) Basic employment information.

(7) Armament subsystem characteristics, capabilities and limitations, description and operation, and components.

(8) Recommended gunnery training on each armament subsystem for pilots, copilots, and door gunners.

(9) Recommended range firing procedures and ammunition for unit training with each armament subsystem.

(10) Aeromedical factors and recommendations pertinent to safe and effective gunnery operations.

d. Guidance is provided for combat operations in—

(1) General war, to include employment of and protection from nuclear and chemical munitions and ground and air threats.

(2) Limited war.

(3) Cold war, to include stability operations.

e. Paragraphs 1-8, 4-12, 5-8, and 7-5c, are the subject of an international air standardization agreement, ASCC Air Standard 44/34, Tactical Formation Flying by Helicopter. Paragraph 1-3 is the subject of an international standardization agreement, STANAG 2134, Offensive Air Support Operations. Chapter 6 is the subject of Quadripartite Standardization Agreement 246, Radio Telephone Procedures for the Conduct of Artillery Fire.

1-2. Recommended Changes

Users of this manual are encouraged to submit recommended changes and comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, United States Army Aviation School, ATTN: ATSAV-DL-L, Fort Rucker, Alabama 36360.

1-3. Definitions

a. *Close Air Support.* Close air support is air attacks against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces. It includes direct aerial fires delivered by attack helicopters, light observation helicopters, door gunners on troop-carrying helicopters, and aerial field artillery.

b. Direct Aerial Fires. The term direct aerial fires (DAF) is used to *delineate specifically those close air support fires delivered by Army aircraft.* Normally, the generic term "close air support" suggests those aerial fires provided by other services through a multiservice air-ground system.

c. Armed Helicopter. An armed helicopter is any helicopter that has a mounted weapon system intended primarily for offensive use.

d. Attack Helicopter. A helicopter specifically designed as an aerial weapons platform to provide direct aerial fire on enemy area and point targets and to supplement the fires of ground-based weapons.

1-4. Roles

Attack helicopters perform two basic roles—*aerial fire support* and *aerial fire delivery with maneuver elements*.

a. Aerial Fire Support. Attack helicopters provide area and point target aerial fire support as integral augmentation of conventional artillery in support of maneuver forces. For direct aerial fire missions, see chapter 3.

b. Aerial Fire Delivery With Maneuver Elements. Integration of an aerial fire delivery means with selected maneuver elements habitually employed as a semi-independent, economy of force, or classical airmobile force operation.

1-5. Mission

A mission, or a capability to perform a specified task, is all encompassing. The attack helicopter can and should be justified only against a military need to provide responsive aerial fire support, either in support of a fire and maneuver element or in integrating an aerial fire delivery means into the fire and maneuver element. Missions include, but are not limited to the following:

a. Providing aerial escort of observation, utility, and cargo aircraft.

b. Attacking personnel in the open.

c. Attacking personnel in improved defensive positions.

d. Attacking armor.

e. Defending against armor.

f. Massing aerially delivered fires.

g. Providing aerial fire support to armored reconnaissance and security elements.

h. Acting as a radio relay activity, etc.

1-6. Concept of Employment for Aerial Fire Support Role

a. Organic Army attack aircraft provide immediate and responsive direct aerial fires for the commander. The attack helicopter has proven to be a suitable platform which can accommodate a variety of weapons responsive to the requirements of the ground commander. By providing readily available direct aerial fires, the attack helicopter increases the number of possibilities available to the ground commander to more effectively apply his combat power. Missions requiring movement into enemy-held terrain can be undertaken with greater probability of success when attack helicopters are an integral element of the attacking force.

b. The concept of using attack helicopter direct aerial fires visualizes their employment to supplement and extend the firepower available to the ground commander from surface weapons and tactical air power. As the Army's capabilities for combat mobility are expanded through the use of organic aircraft, the ability to provide direct aerial fires will also expand. Using appropriate tactics, the attack helicopter contributes greatly to mission accomplishment through its ability to operate in the same environment as the ground force. In addition, it is capable of delivering effective neutralization fire in the objective area at a crucial point in airmobile operations. The number of attack helicopters used on a particular mission will depend upon the airmobile capability allocated to the ground commander and the direct aerial fires required.

c. Attack helicopters play an essential role in augmenting the ground commander's capability for mobile and nuclear warfare. This role is emphasized in those instances where great dispersion of ground forces is required. The quick-reacting direct aerial fires that the attack helicopter can provide the ground commander permit him the widest possible latitude in the assignment of missions.

d. The ground commander controls the fires of all armed helicopters operating in his area of responsibility, to include attack helicopters organic to artillery or armor units and escort helicopters organic to Army aviation units. He may—

(1) Control and coordinate these fires personally,

(2) Have his artillery representative coordinate the fires for him through artillery fire support channels,

(3) Direct a subordinate commander who is on the spot to coordinate the fires, or

(4) Use any other method which he deems appropriate to the situation in controlling these fires.

1-7. Concept of Employment as a Means of Aerial Fire Delivery With Maneuver Elements

a. Attack helicopters are capable of providing escort for airmobile forces. Detailed planning and coordination are necessary. Flight routes are selected which offer ease of navigation, minimum interference from enemy or friendly force activity, planned friendly fire support, and maximum cover and concealment. Nap-of-the-earth flight is used as necessary. En route formations will be determined by the factors of mission, enemy, terrain and weather, and troops and equipment. The armament used on helicopters will depend upon the nature of known and suspected enemy targets. As the element nears the landing zone, lead escort helicopters can depart the formation to conduct landing zone reconnaissance, prestrike, and neutralization fire missions. Centralized control of the entire airmobile force (troops, airlift helicopters, and escort helicopters) is essential during the operation. This control normally is vested in the airmobile task force commander.

b. Attack helicopters also provide escort for ground convoys. The threat of ambush to ground convoys usually is present in rear areas during defensive or retrograde operations in restrictive terrain, and in operations against an enemy adept at infiltration. Stability operations frequently will require aerial escort of ground convoys. The attack helicopter mission commander should conduct a thorough map reconnaissance of all proposed routes and adjacent terrain. He should establish a system of checkpoints, phase lines, and holding areas to be used by his attack helicopter escort. These control measures must be coordinated with the surface convoy commander. If time and security permit, a route reconnaissance should be made prior to conducting the convoy escort. FM 1-100 provides details on aerial escort missions.

c. Effective reconnaissance and security provides much of the information concerning the enemy, terrain, and weather essential to the conduct of operations. When employed with conventional surface reconnaissance elements, attack helicopters extend the overall reconnaissance and security effort. The supported force commander should consider the type of helicopter support required. For the main reconnaissance and security effort, he should consider the observation-type helicopter. The force G2 will coordinate the reconnaissance and security effort and formulate recon-

naissance and security requirements within the force area. During reconnaissance operations, attack helicopters will engage in offensive action as required. FM 17-37 provides details on reconnaissance operations. For operations against irregular forces, see FM 17-36, 31-16, and 31-23.

1-8. Attack Helicopter Section (Fire Team)

a. Mission. The attack helicopter team consists of two or three helicopters and has the primary mission of delivering coordinated direct aerial fires for the ground commander. To provide immediate responsiveness to the requirements of the ground force, coordination of attack helicopter fires will normally be effected directly with the supported force commander or his tactical operations center. Procedures to accomplish the tasks involved in the coordination of fire will vary with the headquarters, the amount and type of fire support available, and the type of operation; however, every effort must be made to establish the attack helicopter unit in the lowest echelon which can effect complete coordination of the fire support mission.

b. Organization. Normally, the basic attack helicopter section is the fire team consisting of two helicopters. When circumstances require and resources permit, a heavy fire team consisting of three attack helicopters may be employed. The helicopters are mutually supporting by both fire and observation. The aircraft commanders of the fire team are—

(1) *Fire team leader.* The fire team leader, designated by the section commander or other commanders in the chain of command, can be the aircraft commander of one of the attack helicopters. He may also be the air mission commander or be responsive to the air mission commander located in another aircraft. His primary responsibility is to insure coordination of the team fires and accomplishment of assigned missions.

(2) *Wingman.* The wingman controls all fires of his crew, and his primary responsibility is to support the fire team leader. This support is typically accomplished by the wingman (and, in a heavy fire team, the third attack helicopter) augmenting the leader's fire or by providing fire for the leader. In an emergency, the wingman is capable of assuming the duties of the fire team leader.

1-9. Fundamentals of Employment of Attack Helicopters

Successful employment of attack helicopters demands responsive and accurate delivery of fires to

meet the requirements of supported ground forces. Consideration of the fundamentals of surprise, flexibility, mobility, and fire and maneuver

will enable the commander of an attack helicopter unit to recommend the best utilization of his unit in the support of the plan of action.

Section II. TYPES OF ARMAMENT

1-10. General

Attack helicopters normally carry a wide variety of armament (fig 1-1) in order to have the widest possible mission profile on each sortie. For information on armament subsystems now in use, see chapters 10, 11, and 12; for a list of ammunition, see appendix C.

1-11. Rifle-Bore Weapons

a. Ammunition. Ammunition for rifle-bore weapons varies from 7.62mm through 40mm. At present, most of this ammunition is percussion fired, with the propellant charge housed in brass casings. The current 20mm and 30mm ammunition is electrically fired.

b. Firing Mode. Rifle-bore weapons may be mounted and fired in either the flexible or fixed mode. The flexible mode allows the gunner to shift his fire rapidly in any flight attitude or altitude.

c. Projectiles. Rifle-bore weapons projectiles vary from simple impact to high explosive. Fuzes for the high explosive projectiles may be point detonating (PD) or proximity type.

1-12. Rockets, Missiles, Warheads, and Fuzes

The rockets/missiles of weapons subsystems provide the standoff capability for attack helicopters.

a. Rockets. Because of their size and ballistic properties, rockets are launched in a fixed forward firing mode. They provide the primary fire required for attack helicopter engagement of area targets. Rockets equipped with antitank warheads may be fired at point targets (tanks).

b. Missiles. Guided missiles provide attack helicopters the capability of engaging point targets (armor, bunkers, gun positions, etc.) with a high probability of first-round hits.

c. Warheads. Guided missiles are capable of carrying a variety of warheads; however, existing stocks contain only practice and high explosive types. Warheads for rockets include various chemical, high explosive, and antitank munitions in different sizes and can be configured with either impact or proximity fuzes.

(1) Area target coverage and neutralization fire against personnel are provided by high explosive fragmentation and blast, flechette, nonlethal

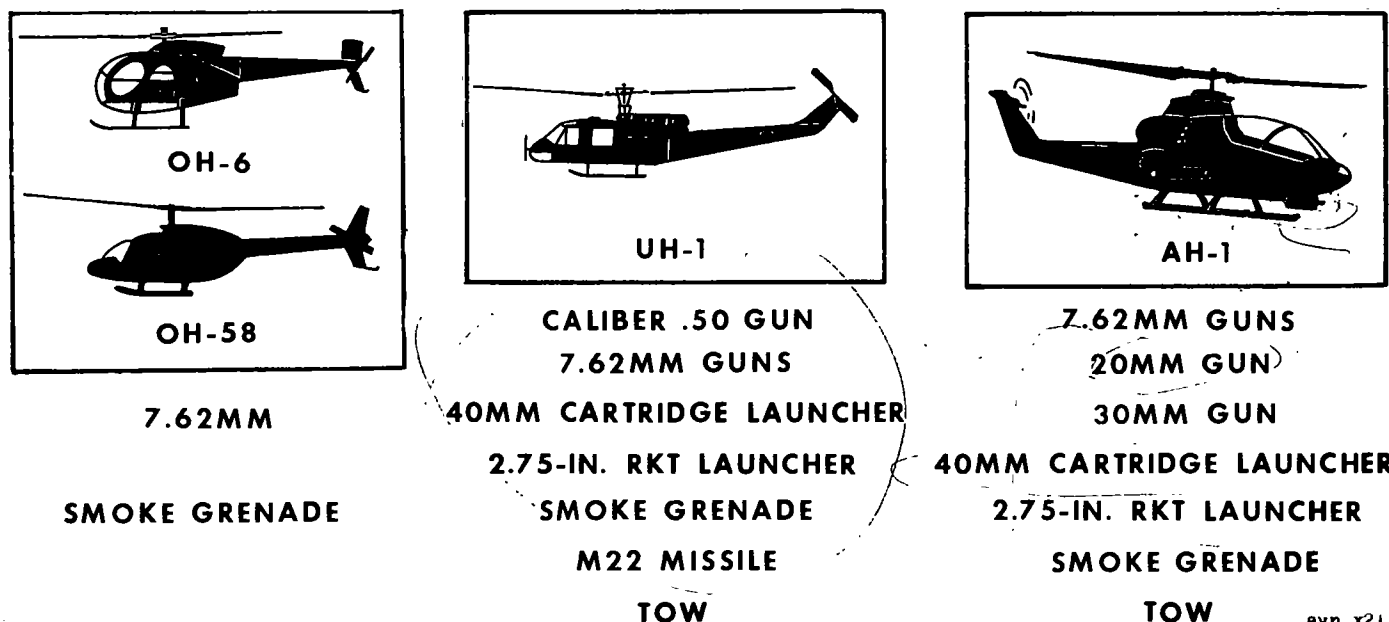


Figure 1-1. Helicopter armament.

chemical CS, and white phosphorus smoke warheads.

(2) Point target effectivity against vehicles, parked aircraft, ammunition fuel storage area, radar equipment, and bunkers is also provided by the high explosive and antitank warheads.

d. *Fuzes*. Fuzes used with each type warhead are classified as—

(1) *Impact*. These fuzes function when projectiles/warheads strike a solid object. Fuze action can be superquick or delay. Guided missiles utilize point initiating, base detonating impact fuzes.

(2) *Proximity*. These fuzes function when they approach an object that reflects the signal radiated from the fuze.

1-13. Droppable Munitions

Although the attack helicopter is not normally employed as the delivery aircraft, the tactical situation may necessitate responsive delivery of droppable munitions to include modified mortar projectiles, cluster bomb units, mines, chemical agents, or flares. Commanders must evaluate the advantages and disadvantages of employing the attack helicopter in this role and integrate their use into the ground unit's plan of action. Such use must be preplanned to insure effectiveness.



CHAPTER 2

FUNDAMENTALS OF HELICOPTER GUNNERY

Section I. ELEMENTARY BALLISTICS

2-1. General

Ballistics is the science which deals with the motion of projectiles and the conditions which affect that motion. The types of ballistics are *interior*, *exterior*, and *terminal*.

2-2. Interior Ballistics

Interior ballistics deals with the factors affecting the motion of the projectile within the tube. Since these factors are fixed for all aerial-fired weapons, they are only defined here.

a. Tube Wear. Movement of the gasses, residues generated by burning the propellant charge, and the projectile, may either wear away the inner surface of the tube or cause deposits to build up within it. Either condition results in a loss of muzzle velocity and may induce excessive yaw.

b. Propellant Charge. Propellant charges for aerial weapons are fixed; however, there are minute differences in muzzle velocity and trajectory due to production variation. In addition, propellant burning is affected by temperature and moisture encountered in the storage environment. This does not normally have a significant effect on flight trajectory.

c. Projectile Weight. Projectiles of the same caliber may vary within tolerance in weight. This is especially true in linked ball and tracer ammunition. The heavier projectile, all other factors remaining unchanged, will have a lower velocity.

2-3. Exterior Ballistics

Exterior ballistics deals with the factors which affect the motion of the projectile as it moves along the trajectory. The trajectory is the path described by the center of gravity of the projectile as it passes from the muzzle of the weapon to the point of impact. Aerial-fired weapons have all the exterior ballistic factors associated with short-range ground-fired weapons plus other factors which are unique because the weapons platform is moving.

a. General Ballistic Factors. Ballistic factors which affect both aerial-fired and ground-fired weapons are—

(1) *Air resistance (drag).* This resistance, caused by friction between the air and the projectile, opposes and reduces the velocity of the projectile. Drag is proportional to both the cross-sectional area of the projectile and its velocity.

(2) *Gravity.* The drop due to gravity is proportional to the square of the time of flight of the projectile. Table 2-1 illustrates examples of the amount of correction necessary for gravity drop.

Note. To compensate for gravity drop when firing in a bank, the elevation of the weapon becomes deflection and it is necessary to aim high and opposite to the direction of bank (para 4-10).

Table 2-1. Gravity Drop

Round	Muzzle velocity (feet per sec.)	Range (feet/meters)	Gravity drop (mils)
7.62mm-----	2,750	3,280/1,000	7.05
20mm-----	3,000	3,280/1,000	5.88
30mm-----	2,200	3,280/1,000	11.00
40mm-----	790	3,280/1,000	86.70

(3) *Yaw.* Yaw (fig 2-1) is the angle between the centerline of the projectile and the trajectory. Yaw increases trajectory and the affected surface area of the projectile and therefore the drag. The direction of the angle of yaw is constantly changing in a spinning projectile—right, down, left, and up. This initial yaw wobble is at a maximum near the muzzle and gradually subsides as the projectile stabilizes. Since the atmosphere offers greater resistance to a yawing projectile, it is fundamental in their design that yaw wobble be minimized and that it quickly dampen out in flight.

(4) *Projectile drift (horizontal plane gyroscopic effect).* US Army projectiles, as viewed from the rear, usually spin in a clockwise direction. A spinning projectile acts as a gyroscope and exhibits the characteristic known as *gyroscopic precession*. When a projectile (with a clockwise spin) has a predominant plus yaw, aerodynamic

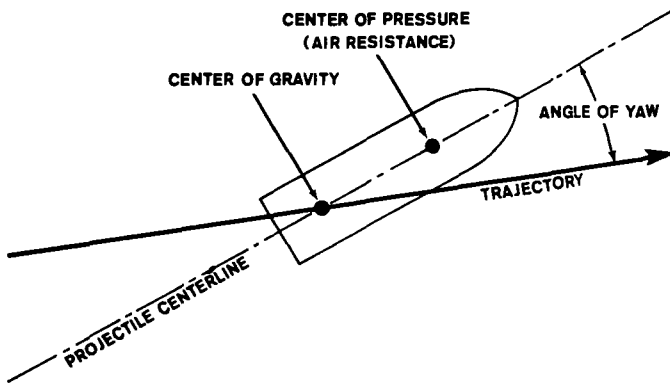


Figure 2-1. Yaw of projectile in flight.

lift and gyroscopic forces cause the projectile to precess, or move to the right. To compensate for this effect, it is necessary to aim to the left of the target (fig 2-2).

(5) *Wind drift.* A projectile fired into a crosswind will drift downwind a distance equivalent to the product of the projectile's time of flight and the windspeed acting on the cross-sectional area of the projectile. Time of flight depends upon the range to the target and the average velocity of the projectile over this range. Firing into a crosswind requires that the weapons be aimed upwind to allow the wind to drift the projectile back to the target. Firing into the wind or downwind will require no compensation laterally, but some adjustment is required in range.

b. Aerial Fire Ballistics. Ballistic factors pecu-

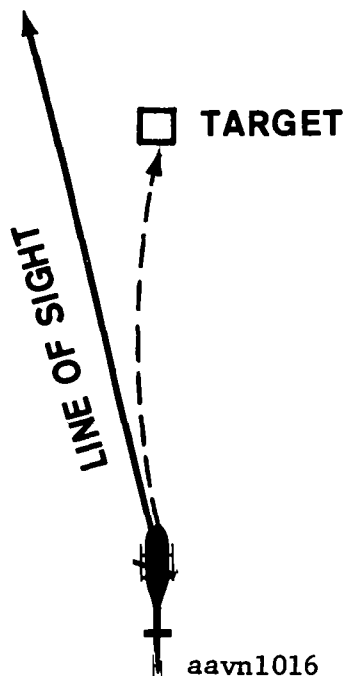


Figure 2-2. Aiming to compensate for projectile drift.

liar to aerial-fired weapons depend upon whether the projectiles are spin-stabilized or fin-stabilized and whether they are fired from the fixed mode or the flexible mode.

(1) *Spin-stabilized projectile.*

(a) *Fixed mode.* Spin-stabilized projectiles fired in the fixed mode (straight ahead of the helicopter) generally have the same ballistic factors common to ground-fired weapons, except the velocity of the platform (helicopter) is added to the velocity of the projectile.

(b) *Flexible mode.* In addition to the general ballistic factors, the ballistic factors affecting spin-stabilized projectiles fired in the flexible mode are—

1. *Trajectory shift.* When the boreline axis of the weapon differs from the flightpath of the helicopter, the velocity of the helicopter causes a change in the direction and velocity of the projectile (trajectory shift, fig 2-3). For deflection shots within 90° of either side of the helicopter heading, trajectory shift causes the round to be left or right of the target. Trajectory shift is corrected by leading the target an amount depending upon the velocity of the helicopter, deflection angle, velocity of the projectile, and target range. Table 2-2 gives some typical lead angle values for firing a 60° deflection shot at 100/200 knots airspeed and 1,000 meters range.

2. *Port-starboard effect.* Addition of the projectile drift factor (a(4) above) results in the *port-starboard effect*, so called because projectiles fired to the port (left) side of the helicopter require that *drift* be added to *shift*, while projectiles fired to the starboard (right) side require that *drift* be subtracted from *shift*.

3. *Projectile jump (vertical plane gyroscopic effect).* If a projectile is fired in any direction other than along the helicopter line of flight, an initial yaw due to the crosswind will be induced. A projectile elevation jump is produced

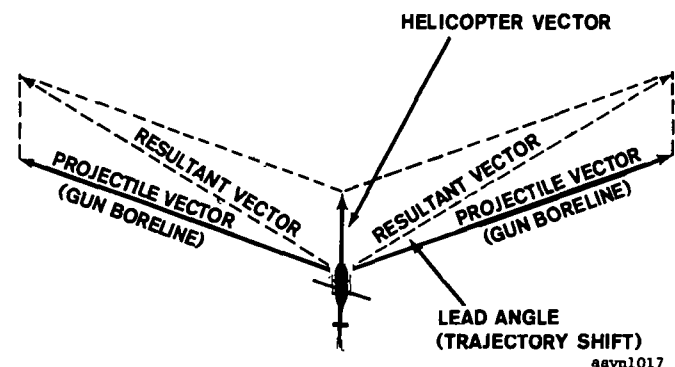


Figure 2-3. Trajectory shift.

Table 2-2. Typical Lead Angle Values for Firing a 60° Deflection Shot at 100/200 Knots Airspeed and 1,000 Meters Range

Round	Muzzle velocity (feet per sec.)	Helicopter velocity (knots)	Lead angle (mils)	Lead angle (degrees)
7.62mm.....	2,750	100/200	51/102	3°/6°
20mm.....	3,000	100/200	47/94	3°/5°
30mm.....	2,200	100/200	64/128	4°/7°
40mm.....	790	100/200	182/364	10°/20°

that is proportional to initial yaw. For a projectile with a right-hand spin, firing to the right produces a downward jump, and firing to the left produces an upward jump. A gunner must aim slightly above a target on the right side of the helicopter and slightly below a target on the left side, even if the helicopter has a fire-control computer. Fire-control computers do not compensate for this effect. The amount of compensation (in the opposite direction from the jump) will increase with increases in helicopter velocity or the angular deflection of the gun.

(2) *Fin-stabilized projectile.* The ballistic factors affecting fin-stabilized projectiles (fig 2-4) are of major importance. These factors are—

(a) *Propellant force.*

1. A bullet has its maximum velocity at the muzzle; however, a rocket continues to accelerate until motor burnout occurs (approximately 1.7 seconds after launch, for present motors). As the rocket reaches its greatest velocity, the kinetic energy that is contained in the rocket tends to overcome other forces and to continue the rocket in a straight line of flight.

2. To provide equalization of thrust from exhaust nozzles, present rockets rotate less than 15 revolutions per second. Since this is not sufficient rotation for significant gyroscopic precession or yaw, these factors may be ignored.

(b) *Center of gravity.* Unlike a bullet, the center of gravity of the rocket is in front of the center of pressure (fig 2-4). As the rocket propellant is consumed, the center of gravity will move farther forward. The primary purpose of the fins

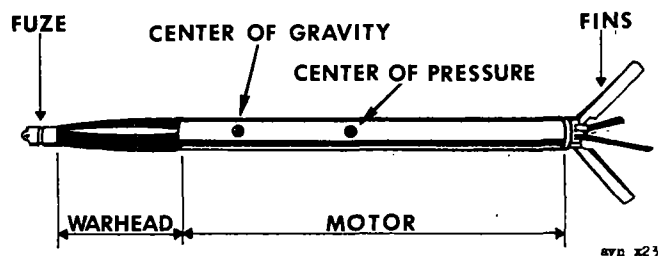


Figure 2-4. 2.75-inch FFAR.

is to insure that the center of pressure follows the center of gravity.

(c) *Crosswind effect.* The rocket will drift with a crosswind in an amount dependent upon the velocity of the wind and the time of flight of the rocket. To compensate for this factor, the pilot/copilot gunner's aim must be approximately 4 mils upwind for each 10 knots of crosswind for UH-1 helicopters. Since helicopter velocity is slower than that of the rocket, the gunner may experience an optical illusion that makes the helicopter appear to displace farther than the rocket (fig 2-5). During the burning phase of the trajectory, the rocket will turn into the wind (similar to the relative wind effect, para 2-3b(2)(d)). During the free-flight portion of the trajectory, the rocket will drift downwind (para 2-3a(5)).

(d) *Relative wind effect.* If the helicopter is out of trim either horizontally or vertically at rocket launch, a relative wind will be created that will be other than the launch axis of the rocket. This relative wind acts on the larger surface area of the fins and causes the rocket nose to weather-

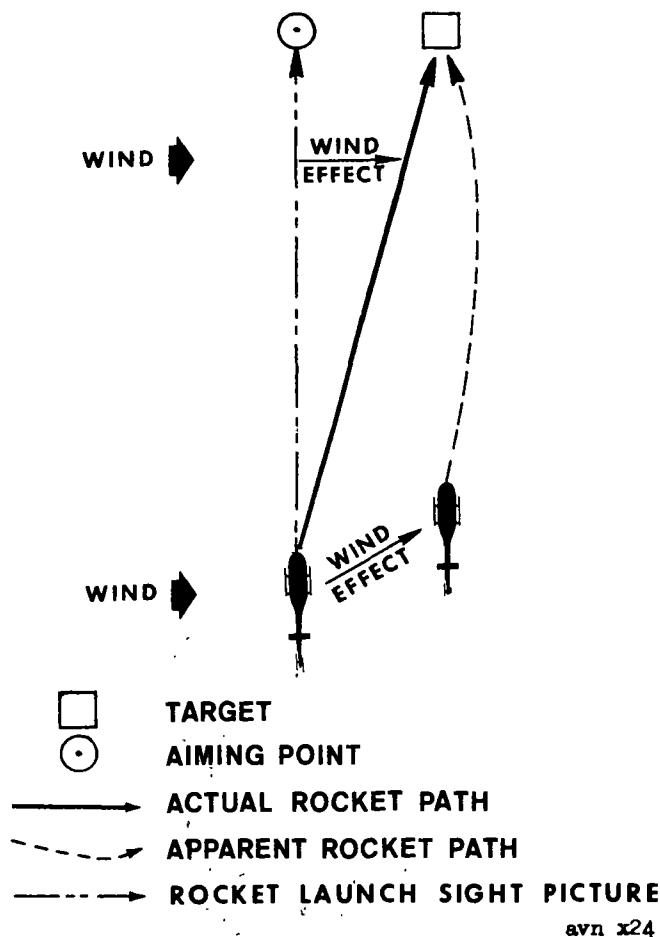


Figure 2-5. Optical illusion of rocket curving into the crosswind.

vane into it. For example, if the helicopter is 10° out of trim and the launch airspeed is 100 knots, the rocket will turn from about 3° to 5° into the relative wind. From this point it will drift downwind at the same speed and direction the wind is blowing.

1. A horizontal out-of-trim condition (A, fig 2-6) is usually the result of the pilot trying to maintain a straight groundtrack to the target by cross-controlling (or slipping) the helicopter. Inaccurate rocket fire is often the direct result of firing out of trim; consequently, trim is an important factor.

2. A vertical out-of-trim condition (B, fig 2-6) is the result of improper power setting (power setting being a function of airspeed, rate of descent, and aircraft load) which creates a vertical relative wind on the rocket at launch. For example, a rocket fired while the helicopter is in autorotation has a relative wind from below the helicopter; it will weathervane into the relative wind and impact short of the target. To maintain a good vertical trim condition, adjust the power setting to maintain the desired airspeed and rate of descent for dive control, harmonize the sight at 1,250 meters (midrange of the rocket, UH-1) or 1,500 meters (midrange of the rocket, AH-1G) at this power setting, and then use this predetermined power setting when firing.

(e) *Miscellaneous factors.* Using the same motors, heavier warheads (in contrast to lighter ones) provide smoother launchings and greater accuracy. Other unpredictable factors which cannot be compensated for are—

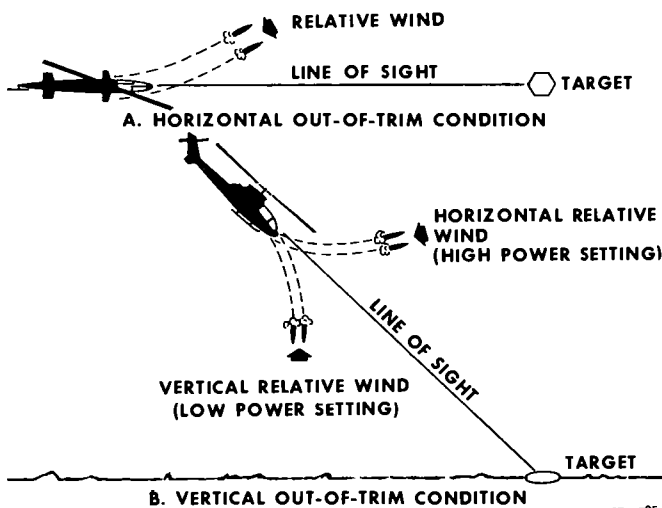


Figure 2-6. Relative wind effect.

1. Unequal burning of propellant, causing an erratic rocket flight.

2. During salvo fire, turbulence created by previous rockets, causing rockets to appear unstable.

3. Rockets with varying size warheads having different trajectories and terminal velocities. Unless the helicopter is equipped to select individual rockets, they should never be fired as mixed loads.

2-4. Terminal Ballistics

Terminal ballistics concerns those factors which affect the projectile at the target. Projectile functioning (i.e., blast, heat, fragmentation, etc.) is influenced by fuze functioning and warhead/fuze selection, angle of impact, and surface condition.

a. *2.75-Inch FFAR Warhead/Fuze Selection.* For a list of warheads and fuzes for the 2.75-inch FFAR, see appendix C.

b. *Angle of Impact.* The angle at which the projectile strikes the target area affects the fragmentation pattern. When fired at low impact angles, fragmenting warheads create an elongated cone of fragmentation (fig 2-7).

c. *Surface Condition.* The condition of the target surface area will affect the lethality of the projectile. If superquick fuzed projectiles are employed in terrain covered with heavy, tall foliage, the fuzes will function high in the tree canopy with little or no lethal effect at ground level. However, airburst lethality will depend on height and density of foliage.

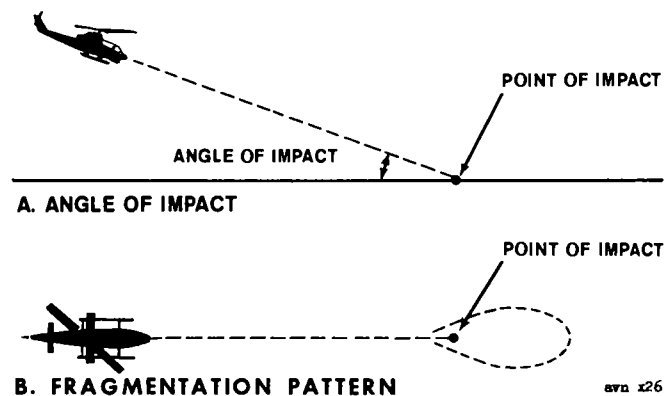


Figure 2-7. Fragmentation patterns produced by low impact angle of projectile.

Section II. DISPERSION

2-5. General

a. If a number of projectiles are fired from the same weapon with the same settings in elevation and deflection, the point of impact of the projectiles will be scattered both laterally (in deflection) and longitudinally (in range) about the mean point of impact of the group of rounds. The degree of scatter of these rounds in range and deflection is called *dispersion*. The location of the mean point of impact with respect to the target center (or the intended aim point) is an indication of the *accuracy* of the weapon. Both of these factors, dispersion and accuracy, will determine the ability of a particular weapon to hit an intended target.

b. Dispersion is caused by errors inherent in firing the projectile. These errors are caused, in part, by—

(1) *Conditions in the bore.* Muzzle velocity is affected by minor variations in weight, moisture content, and the temperature of the propellant charge; variations in the arrangement and content of the powder grains; differences in the ignition of the charge; differences in the weight of the projectiles; and variations in the temperature of the bore or tube.

(2) *Conditions in the mount.* Deflection and elevation are affected by looseness in the mechanism of the mount and unequal reaction to firing stresses.

(3) *Vibrations in the mount.* Since the mount is fixed to the helicopter, vibrations in the helicopter are transmitted through the mount and affect both deflection and elevation.

(4) *Conditions during flight.* From round to round, air resistance (drag) is affected by differences in weight; velocity; form of projectile; and changes in wind, air density, and temperature.

2-6. Cone of Fire

For any large number of rounds fired, it is possible to draw a cone within which the trajectories of all the rounds will fall. Since the dispersion is considered equal throughout the cone, the *mean trajectory* is found anywhere along the length of the center of this cone. If a plane surface intersects the cone perpendicular to the mean trajectory, the dispersion pattern on the plane surface will be circular (fig 2-8).

2-7. Circular Error Probable

In a plane perpendicular (normal) to the mean

trajectory of a group of rounds, the circular error probable (CEP) is defined as the radius of the smallest circle centered about the (true) center of impact of the group which includes 50 percent of the projectile impact points. This circular error probable can be expressed in units of length, e.g., meters, feet, inches, or in mils, whichever is convenient.

2-8. Dispersion Pattern

In a plane normal to the mean trajectory, the pattern of normally distributed impact points will be circular. However, as the impact surface changes from normal to oblique with respect to the mean trajectory, the pattern of impacts will become elongated. In most cases, a distance of 4 CEP in deflection and range or a circle of a radius equal to 4 CEP, will contain virtually all impact points in the normal plane. In the ground plane, the size and shape of the pattern which will contain virtually all impact points will depend on the angle of attack and the resulting angle of projectile impact (fig 2-9).

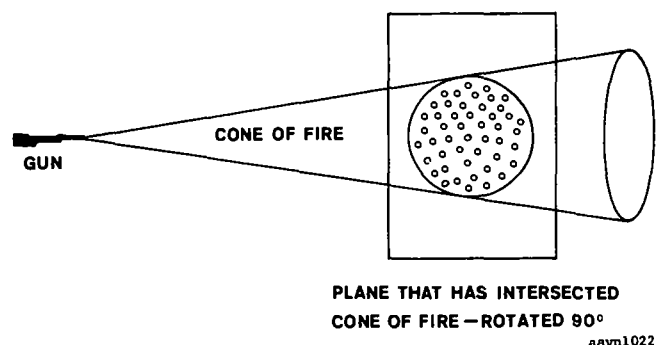


Figure 2-8. Circular dispersion pattern on plane intersecting cone of fire.

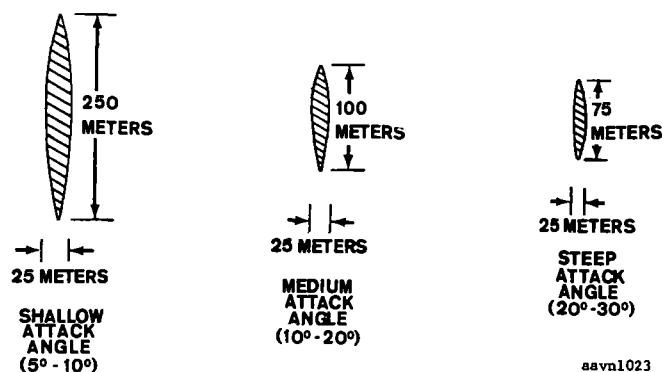


Figure 2-9. Elongated beaten zone for 7.62mm machinegun.

Section III. HELICOPTER GUNNERY FIRING DATA

2-9. General

For a projectile fired from a helicopter weapons system to impact at the desired point, data is required on the direction, horizontal or slant range, weapon selected, speed of helicopter, sight picture, and desired pattern of impact at the target. Although the unit of angular measurement most commonly used for helicopter navigation is the degree (1/360 of the circumference of a circle), it is too large a unit for the aiming of weapons. The principal unit of angular measurement for aiming weapons is the mil (1/6400 of the circumference of a circle). At a thousand meters, an angular deflection of 1 mil results in a deflection of 1 meter. Due to altitude, airspeed, and angle of attack, elevation or depression of 1 mil results in varying distances of error at a thousand meters.

2-10. Direction to the Target

The direction from which attack helicopters may engage targets will depend upon the tactical situation. Direction is expressed as a measurement from a reference direction, usually magnetic north. (See chap 4 for factors affecting target engagement.)

a. Degree Method. Normally helicopter heading is expressed in degrees, with magnetic north as the reference direction. When the degree is used as the method of stating headings in helicopter attacks, usually the nearest 5° heading is given (e.g., 220°, 225°, etc.). A polar plot is obtained by indicating range and direction angle (e.g., heading 080°, range 1,500 meters). Usually the helicopter is the reference or focal point (fig 2-10).

b. Cardinal Heading Method. Using magnetic north as the reference direction, helicopter attack headings may also be expressed as cardinal compass point (e.g., 225° SW, 045° NE, etc.). A polar plot (fig 2-11) is obtained by adding range to the direction (e.g., bearing NE, range 3,000 meters).

c. Clock Method.

(1) Between aircraft commanders of an attack helicopter element, the clock method of expressing heading is most commonly used for identifying targets, positions, etc. The nose of the helicopter is always at the 12 o'clock position; target direction is measured clockwise from this 12 o'clock position. For example (fig 2-12), "Target at my 3 o'clock, range 500 meters."

(2) The clock method can also be applied to landing zone operations. For this method, the 12 o'clock position is always the direction of landing.

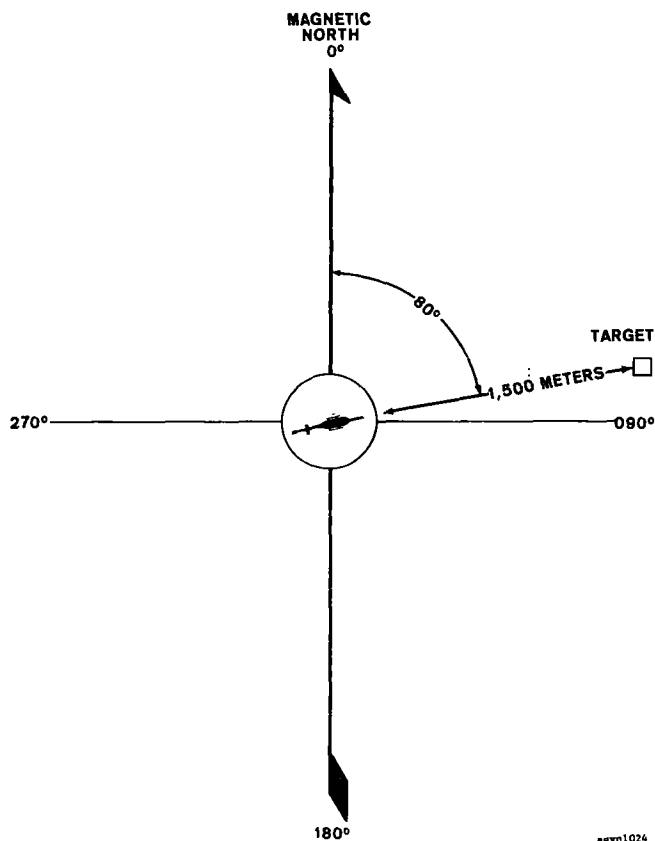


Figure 2-10. Degree method of referencing the target.

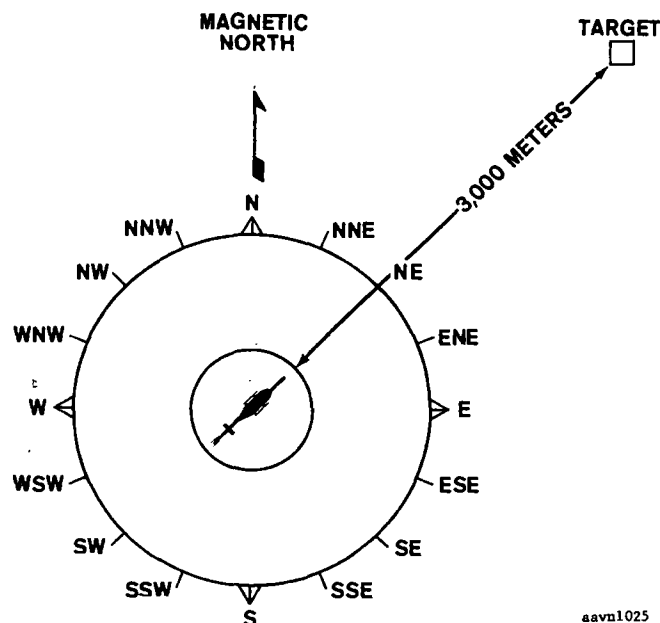


Figure 2-11. Cardinal heading method of referencing the target.

During combat assaults, the clock method provides an accurate and rapid means of pinpointing sources of hostile resistance.

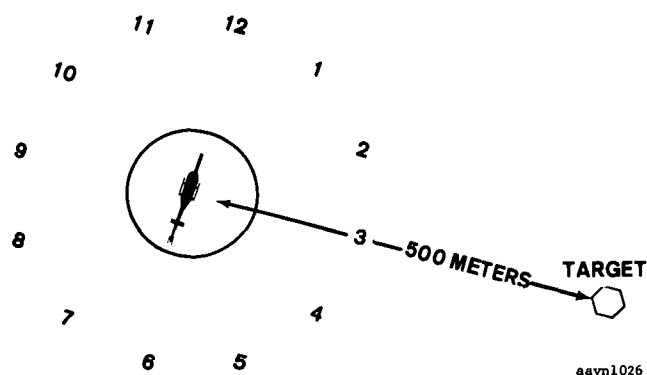


Figure 2-12. Clock method of referencing the target from the helicopter heading.

2-11. Range

Range (fig 2-13) may be expressed either as horizontal range (horizontal distance from a point below the helicopter to the target) or slant range (range from weapons to the target). Range is expressed in meters and may be measured graphically, measured electronically, or estimated. The range of any projectile is a function of the muzzle velocity (or terminal velocity for rockets) and the elevation of the tube. Elevation for helicopter gunnery is measured from the line of sight, and may be either positive (elevation) or negative (depression).

2-12. Speed of Helicopter

When closing with the target, helicopter speed requires a continual reestimating of range. As helicopter speed increases, deflection shots must have the correct lead factor applied to correct for trajectory shift.

2-13. Sight Picture

Because of the rapidly changing position of the helicopter in flight, application of the correct sight picture (chap 4) is more critical with aerial-fired weapons than with weapons fired from a fixed position.

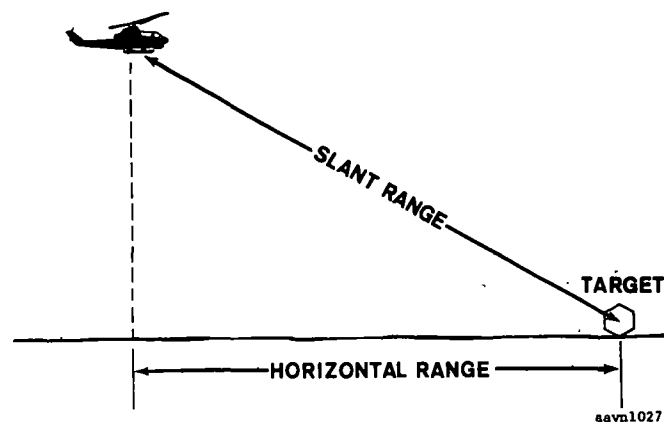


Figure 2-13. Range.

2-14. Pattern of Impact

Distribution is the pattern of impact (beaten zone) in the target area. When possible, attack helicopters engage the target with *enfilade fire*. This means that the long axis of the beaten zone coincides with the long axis of the target. The size and shape of the beaten zone depends upon the attack angle of the weapon and the surface configuration. Attack helicopters may deliver diving fire, running fire, or hovering/slow flight fire.

a. Diving Fire. Diving fire gives a nearly concentric beaten zone about the target. The size of the beaten zone depends upon the slant range, attack angle, weapons system used, and surface configuration.

b. Running Fire. Running fire may be delivered at any altitude with the helicopter in a level-flight attitude. Running fire results in a beaten zone, the size and dimensions of which vary with altitude, slant range, weapons system used, and surface configuration.

c. Hovering/Slow Flight Fire. Hovering/slow flight fire should be delivered while the helicopter is in a concealed position. When delivering hovering/slow flight fire, the beaten zone of fire is extremely elongated.



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PART TWO

DIRECT AERIAL FIRES

CHAPTER 3

DIRECT AERIAL FIRE MISSIONS

Section I. GENERAL

3-1. Direct Aerial Fires

Direct aerial fires (para 1-3b) delivered against hostile targets near friendly forces require detailed integration of each air mission with the fire and movement of the friendly forces. Coordination by the attack helicopter commander and the ground commander allows helicopter direct aerial fires to supplement and be integrated into the committed firepower of the ground force. For details on command and control of direct aerial fires, see paragraph 6-1.

3-2. Rules of Engagement

Since uncontrolled aerial helicopter fire is ineffective and dangerous, attack helicopter aircraft commanders must have positive control of their crews at all times. Crews only fire if permission has been granted by prearrangement or by requesting and receiving clearance as targets of opportunity occur. Prearrangement may include mission briefings, establishment of no-fire areas, or defining rules of engagement for a particular mission. When firing in close support of friendly forces, all firing must be closely coordinated. Before targets of opportunity acquired in an unexpected area may be engaged, they must be cleared by the commander (or his designated representative) responsible for that area. All attack helicopter personnel must know and observe the following rules of engagements. Attack helicopters will fire only when—

a. Under positive control and in direct radio communication with the designated control agency.

b. The target or target marks can be readily identified.

c. Friendly and civilian positions are positively identified.

d. They are defending themselves against ground fire and—

(1) The source can be visually identified.

(2) The strike can be positively oriented against the source.

(3) The intensity of fire warrants counteraction.

3-3. Types of Attack Helicopter Fires

The three general types of attack helicopter fires are *neutralization fires*, *destruction fires*, and *combined fires*. The distinction between these types depends upon results desired, weapons selected, and slant range to the target.

a. *Neutralization Fires*. To maintain fire on target, neutralization fires often are first delivered with heavy intensity and then followed by subsequent fires of lesser intensity. These fires are delivered for the purpose of reducing the combat efficiency of the enemy by—

(1) Hampering or interrupting the fire of his weapons.

(2) Reducing his freedom of action.

(3) Reducing his ability to inflict casualties on friendly troops.

(4) Severely restricting his movement within an area.

b. *Destruction Fires*. Destruction fires are those delivered for the sole purpose of destroying enemy troops and equipment.

Note. When practicable, poststrike analysis is an assumed task requirement with all destruction fires.

c. *Combined Fires*. Since attack helicopters can carry more than one type of ammunition and armament, fires may be combined. For example, neutralization fires may be used to protect the helicopter while it is engaged in destroying a point target. These fires may come from the air-

craft engaged in destruction fires or from other supporting aircraft.

3-4. Categories of Weapons

Weapons are categorized as *area target weapons*, *point target weapons*, or *dual-purpose weapons*. The category of each weapons system is determined by the inherent accuracy of the weapons system, the terminal ballistic characteristics of its projectile, and the volume of fire delivered.

a. Area Target Weapons. Area target weapons include 7.62mm, 20mm, and 30mm automatic guns; 40mm grenade launchers; and 2.75-inch FFAR launchers. Because of inherent inaccuracies of area target weapons systems, they have a low probability of first-round hits. The terminal effect of area target ammunition ranges from the impact of many projectiles fired from an automatic gun to a single 2.75-inch FFAR antipersonnel warhead that, upon detonation, breaks into thousands of small, high velocity fragments.

b. Point Target Weapons. Point target weapons require a high probability of first-round hits. Normally, point target weapons use a shaped-charge warhead capable of penetrating armor plating. Point fire is delivered by the wire-guided missile system.

c. Dual-Purpose Weapons. Dual-purpose weapons, such as the 30mm automatic gun and 2.75-inch FFAR, fire ammunition that is designed to be effective against personnel and light-armor materiel. The 2.75-inch FFAR can also be configured with a dual purpose antitank/antipersonnel warhead.

3-5. Attack Helicopter Employment

The types of targets best suited for attack helicopters are those that are relatively soft, small, lightly defended by anti-aircraft weapons, difficult to detect, transitory, or very close to friendly

troops. Attack helicopters are the preferred system of aerial attack when—

a. Friendly troops are less than 200 meters from the target.

b. Targets are appearing in a changing and fast-moving situation requiring rapid response time, multiple target acquisition or tracking, direct communications, and close coordination.

c. The target dictates that reaction to the ground commander's desires be immediate, closely integrated with the direct and indirect fires employed by the ground unit, and coordinated with the unit maneuver plan.

d. Armament on fixed wing aircraft would present hazards to the safety of friendly forces.

e. Discrete fires of minimum destruction are required for combat in populated areas.

f. The enemy is well-dispersed and concealed.

g. Preparation fires are needed on landing zones while transport helicopters are on final approach.

h. Fire support is needed during the insertion or extraction of long range patrols.

i. Neutralization fire is required to permit friendly maneuvers.

j. Reconnoitering of the target area is required.

k. Enemy action effectively closes runways required for fixed wing attack aircraft.

l. Neutralization fire is needed on heavily fortified positions pending arrival of heavier fire support.

m. Tactical chemical agent irritant CS fires are required. CS munitions are also effective against targets cited in *a* through *c*, *f* through *j*, and *l* above. For details on tactical employment of riot control agent CS, see FM 3-2.

Section II. PREPLANNED DIRECT AERIAL FIRES

3-6. Preplanned Fires

Preplanned fires are those that are planned in advance of takeoff. These fires are closely coordinated with the ground force commander and his fire support coordinator to insure support of the ground tactical plan. Planning normally includes target location, type and amount of weapons and ammunition, time of delivery, technique of delivery (chap 4), and method of adjustment (chap 6).

3-7. Target Acquisition and Control

Targets are acquired by all available means. Targets acquired by the ground element are engaged and controlled under the direction of the ground force commander (or his designated representative) to support his ground tactical plan. Engagement of targets acquired by other means will be in accordance with existing directives or policies of the supported headquarters.

3-8. Preplanned Fires on Area Targets

Preplanned area target fires, as with other supporting fires, are normally conducted to support a ground maneuver plan. Common preplanned area target fires are—

a. Preparation. Before the initiation of an assault, a heavy volume of preparation fire is delivered on a suspected or known enemy position. Various types of ammunition may be used in firing preparations for airmobile, amphibious, and airborne assaults; ground offensives; or raids.

b. Diversionary. Diversionary fires are delivered into an area to draw attention to it, with the intent that enemy forces may be drawn away from that principal area of operation. Diversionary fires may be used as an economy-of-force measure or in conjunction with ground offensive, defensive, or retrograde operations. The type ammunition to use is determined by the situation.

c. Harassing. Harassing fires are those delivered into an area for the purpose of disturbing the rest, curtailing the movement, and lowering the morale of enemy troops by the threat of casualties or losses in materiel.

d. Interdicting. Interdicting fires are those delivered for the purpose of denying the enemy the unrestricted use of an area or point. Interdiction fire is usually of less intensity than neutralization fire.

e. Counterpreparation. Counterpreparation fire is intensive prearranged fire delivered when the imminence of an enemy attack is discovered. It is designed to break up his formations; disorganize his system of command, communication, and observation; decrease the effectiveness of his fire support; and impair his offensive spirit.

Section III. IMMEDIATE DIRECT AERIAL FIRES

3-9. Target Acquisition and Fire Control

The requirement for *immediate fires* arises from targets of opportunity or changes in the tactical situation. Immediate fire targets may be acquired by any individual or element in the battle area; however, within his area the ground commander is responsible for the control of these fires. All immediate fires require close coordination of the fire team leader and the ground commander or his fire support coordinator.

3-10. Immediate Fires on Area and Point Targets

In the fluid, fast-moving situations found in unconventional warfare, attack helicopters, without previous planning, may provide a base of fire for maneuvering elements. Common immediate area and point target fires are—

a. Preparation. A change in the forecasted tactical situation may require the firing of preparation fires into an area other than where originally planned. The rapid-reaction capability of attack helicopters permits their recall from a lower priority mission to fire preparation for an assault.

b. Interdicting. As the tactical situation develops, immediate interdicting fires in support of the ground force may become necessary. To achieve good timing and target location and to locate friendly elements, interdicting fire delivery must be closely coordinated with the ground commander (or his designated representative).

c. Targets of Opportunity. Targets of opportunity are those targets that randomly appear within the battle area and for which neutralization or destruction is desired. They should be engaged only when the engagement does not interfere with the primary tactical mission.

d. Countermeasure. The countermeasure for fire received from a concealed or nonsuspected source is *snap fire*. It is return fire that is neutralizing and defensive in nature.

e. Destruction Fires. Effective point target engagement normally requires that the target be clearly discernible at relatively greater ranges than for area targets; generally, the point target is acquired by the ground unit. The advantages of engaging these targets at maximum standoff distance are—

(1) Attacking helicopters have a high probability of first-round hits beyond the effective range of enemy small arms fire.

(2) Attack helicopters engaging targets several thousand meters in front of friendly positions provide friendly ground units reaction time and space to maneuver.

3-11. Type of Target

The type of ammunition used will depend on the type of target, as follows:

a. Soft. Soft (i.e., lightly armored) point targets will require high volume, short duration fires using all available weapons.

b. Hard. Hard (i.e., heavily armored or bunk-

ered) point targets place a different requirement on the pilot if he is to break contact successfully. Hard targets require larger caliber weapons, which presently are fired from the stowed mode. This requires that the pilot maneuver the helicopter to engage the target straight on.

c. Hostile Aircraft. Countermeasure fire against

hostile aircraft allows the use of almost any type of weapon presently in the inventory. Some weapons systems require a high volume of fire to saturate the flightpath of the hostile aircraft. Other types of weapons are sufficiently accurate and responsive to allow a small expenditure of ammunition with a high probability of first-round hits.

Section IV. NIGHT DIRECT AERIAL FIRES

3-12. General

Attack helicopters will normally be expected to provide the same quality and types of direct aerial fire at night as they provide during daylight hours. To provide this fire requires well-trained crews who are aware of their capabilities and limitations.

3-13. Factors Affecting Employment

When it is understood that visibility at night could work to the advantage of the attack helicopter team, the factors of METT (mission, enemy, terrain and weather, and troops and equipment) and the established rules apply equally as well to night operations. Attack helicopters can operate at altitudes and ranges which optimize accuracy using the cover of darkness to limit observation. However, enemy radar acquisition capability will limit this advantage.

3-14. Measures to Prevent Loss of Night Vision

Alcohol consumption and smoking (by causing a deficiency of oxygen reaching the body tissues) may decrease night vision. Also, bright light can rapidly destroy night vision. For further details on measures to prevent loss of night vision, see appendix D.

3-15. Planning

Planning for night target attacks requires considerable care and coordination. Even with experienced crews, a detailed premission briefing is required. Included in the briefing are—

- a.* Location, call sign, and frequency of supported unit.
- b.* Target location and method of identification.
- c.* Time schedule (i.e., takeoff, en route, on station, off station, etc.).
- d.* Call sign and frequencies of en route and target area artillery.
- e.* Call sign and frequency of radar control facility.

f. Call sign and frequency of tactical air support.

g. Downed crew and other emergency procedures (unit SOP).

h. Procedures upon receipt of hostile fire.

i. Formations and altitudes to be used.

3-16. Control Measures

a. Orbit Point. Several orbit or rallying points may be established in the vicinity of the battle area so that helicopters can be quickly assembled at any time during or after the attack. These points should be readily identifiable by a navigation fix or by relative position to prominent terrain features such as rivers and towns.

b. Altitude. Night operations by attack helicopters are initiated from higher flight altitudes than daylight operations. Normally, it is not feasible to make nap-of-the-earth firing runs at night without illumination or special visual aids. Termination of firing runs should also be completed at a higher altitude, especially in uneven, hilly, or mountainous terrain.

c. Attack Headings. The attack helicopter commander or a control aircraft situated overhead can give attack headings to be flown for the firing runs. Vectoring aids control and reduce confusion in the target area.

d. Troop Safety Buffer Zone. A larger troop safety buffer zone must be established for night operations to preclude attack helicopters firing into friendly positions. Its location should be defined by easily identifiable terrain features or lighting devices.

e. Formations. Night formations will require greater separation between helicopters. Minimum lighting of a type to preclude observation from the ground should be used during formation flying over hostile areas. For details on night formation flying, see TM 1-260.

3-17. Helicopter Lighting

a. Cockpit. The panel lights should be as dim as possible during all phases of night operations to preclude canopy glare and yet allow the instruments to be adequately illuminated. Flashlights with red lens covers should be used only when necessary for map scrutiny, and then as briefly as possible.

b. Exterior. If the helicopter is not equipped with special night lighting devices, the following guidance should be followed:

(1) Only those lights essential to the successful conduct of the mission should be used. The bottom half of the navigation lights should be masked.

(2) In an emergency, additional exterior lighting should be used to aid other aircraft in locating a particular helicopter. If an aircraft is forced down in a hostile area, lights should be used only as necessary until its location has been determined.

(3) The searchlight and landing light should be in the extended position so that they can be quickly used if the helicopter is forced down.

3-18. Effect of Enemy Searchlights

Enemy searchlights focused directly on attacking helicopters produce a serious problem. Evasive action must be initiated immediately. A new approach angle and attack direction should be selected that will restrict the capability of the enemy searchlight. When feasible, the searchlight should be destroyed by fire.

3-19. Helicopter Servicing

a. Approach and Landing. Helicopters will make approaches to a lighted servicing area, and ground personnel will guide the helicopter to preselected parking locations within the area. If possible, the attack helicopters should approach and land at the preselected parking locations, thereby eliminating hovering and movement in the servicing area.

b. Rearming and Refueling. The helicopter may be refueled and rearmed with the engine running, provided positive control is exercised and appropriate safety precautions are observed. Colored lights and ground guides should be used to direct the helicopter crews to the parking areas where ammunition is stacked and fuel is stored. Personnel used to rearm and refuel during the hours of darkness must be well trained and must have performed like functions numerous times during daylight hours.

3-20. Natural Illumination

a. Advantages and Disadvantages. Target attacks using natural lighting at night provide certain advantages which are to possible when using flare or lighting system (e.g., Firefly) illumination.

(1) *Advantages are—*

(a) The element of surprise is maintained longer.

(b) Night vision is conserved for observation.

(c) All helicopters in the team maintain the security provided by the darkness.

(d) Ground fire is more readily seen.

(2) *Disadvantages are—*

(a) Target area and targets are more difficult to identify.

(b) Range is more difficult to determine.

(c) Even after initially identified, target locations are more difficult to maintain.

(d) Due to muzzle and rocket flash, night vision is lost during a target attack.

(e) Pilot is more susceptible to target fixation (para 4-2d).

b. Target Identification. Target identification under natural light conditions at night may be difficult. As with daylight attacks, friendly positions must be positively known before commencing the attack. Positive radio contact is essential before the friendly positions are marked. *Commanders must caution friendly troops not to mark their positions by firing tracers upward into the air.* Friendly ground troops should only mark their position by firing into the target area. Several satisfactory methods of marking friendly positions and target locations are to—

(1) Have friendly flank positions fire tracers into the target area.

(2) For fortified positions, use the "flaming arrow" technique (fig 3-1). The arrow is made of wood mounted on a pivot. The flames are made by flare pots attached to the arrow. The distance from the arrow to the target can be provided by radio communication from the ground observer to the attack helicopter crew.

(3) Have friendly troops mark their position with strobe lights and give range and azimuth to the target. Since strobe lights sometimes resemble muzzle flash, radio contact is made before using them. Use of codes or voice scrambler radios will add to security and prevent disclosure of friendly positions.

c. Attack Formation. Because of the danger of midair collision and since navigation lights are

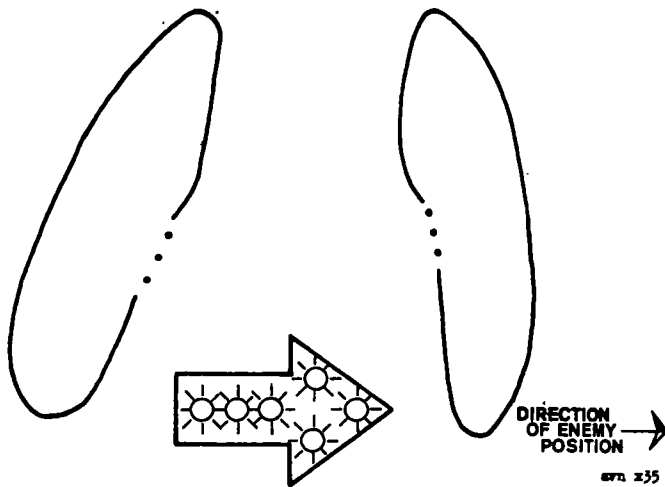


Figure 3-1. Marking target with a flaming arrow.

visible only from above, the wingman will normally fly at least 100 feet higher than the fire team leader. The prescribed formation must be rigidly adhered to at night, since everyone in the formation must know the location of the others. Standard procedure may be to assign airspace limitations in which each helicopter must operate unless given permission to deviate. For example, the lead helicopter will operate below 800 feet indicated altitude, the second helicopter between 900 and 1,000 feet, and the third helicopter (in a heavy fire team) above 1,000 feet indicated altitude.

d. Attack Patterns. The attack pattern most commonly used at night is the racetrack (fig 4-5). Because of the degree of control required for more advanced or intricate patterns, they are not suitable for night attacks. The racetrack pattern will normally be extended to allow sufficient time to insure that preceding helicopters are well clear of the target area prior to initiation of the attack run.

(1) Since muzzle flash and tracer fire will disclose the helicopter's position, automatic gun fire should be kept to short bursts.

Caution: Short bursts have a tendency to cause a malfunction of the automatic gun.

(2) Rocket and grenade fires do not readily disclose the helicopter's position. Thus, to increase accuracy, these fires can be carried to lower altitudes and closer ranges than during daylight attacks.

3-21. Artificial Illumination

Artificial illumination consists of all manmade light-producing or light-amplification devices which can be used to enhance target acquisition and sighting. These devices include flares, lighting

systems (e.g., Firefly), infrared systems, and low light level television (LLLTV).

a. Flares. Flare illumination is provided by either aircraft flares or artillery illuminating rounds. It is a high intensity, short duration method of illuminating the target area. During periods of good weather conditions, flares can be used effectively to identify and illuminate targets for attack helicopters. However, because of the danger of encountering flare parachutes during target attacks, flares should be employed far enough away from the target so that the attack helicopters are well clear of the point. When friendly ground troops are closely engaged, flares will normally be dropped directly over their positions; this will illuminate the target without blinding the friendly troops. For further details on the employment of aircraft flares from Army aircraft, see TC 1-16.

b. Airborne Lighting Systems. Airborne lighting systems can be used effectively to illuminate targets for night helicopter attacks. However, the use of these systems is somewhat restricted during periods of poor visibility such as haze, fog, rain, and snow. The small particles of precipitation in the atmosphere reflect the high intensity light sufficiently to illuminate the cockpit. This illumination can reduce night vision for as long as 30 to 40 minutes and requires the pilot to rely on the instruments rather than following the terrain features. The major advantage of airborne lighting systems is that they provide relatively long term, highly selective illumination. When the light is on, the airborne lighting system also curtails nearly all overt enemy activity within the area of operation. An example of an airborne lighting system is the Firefly (fig 3-2), with characteristics as explained below.

(1) To allow sufficient room for the attacking helicopters to maneuver and for the light to illuminate a maximum area, the light is normally employed above 500 to 600 feet absolute altitude.

(2) Once the target is located, the helicopter carrying the light orbits the target, maintaining the illumination until the mission is complete. These orbits should be large enough to maintain sufficient airspeed for protection, but not so large that the light is ineffective.

(3) In addition to the primary cone of light produced by the Firefly, there is also an area of secondary illumination (halo area) (fig 3-2). In the halo area, the illumination is inadequate for target engagement but is sufficient to silhouette the attacking helicopters. For this reason, the attack run should be discontinued before reaching the halo area.

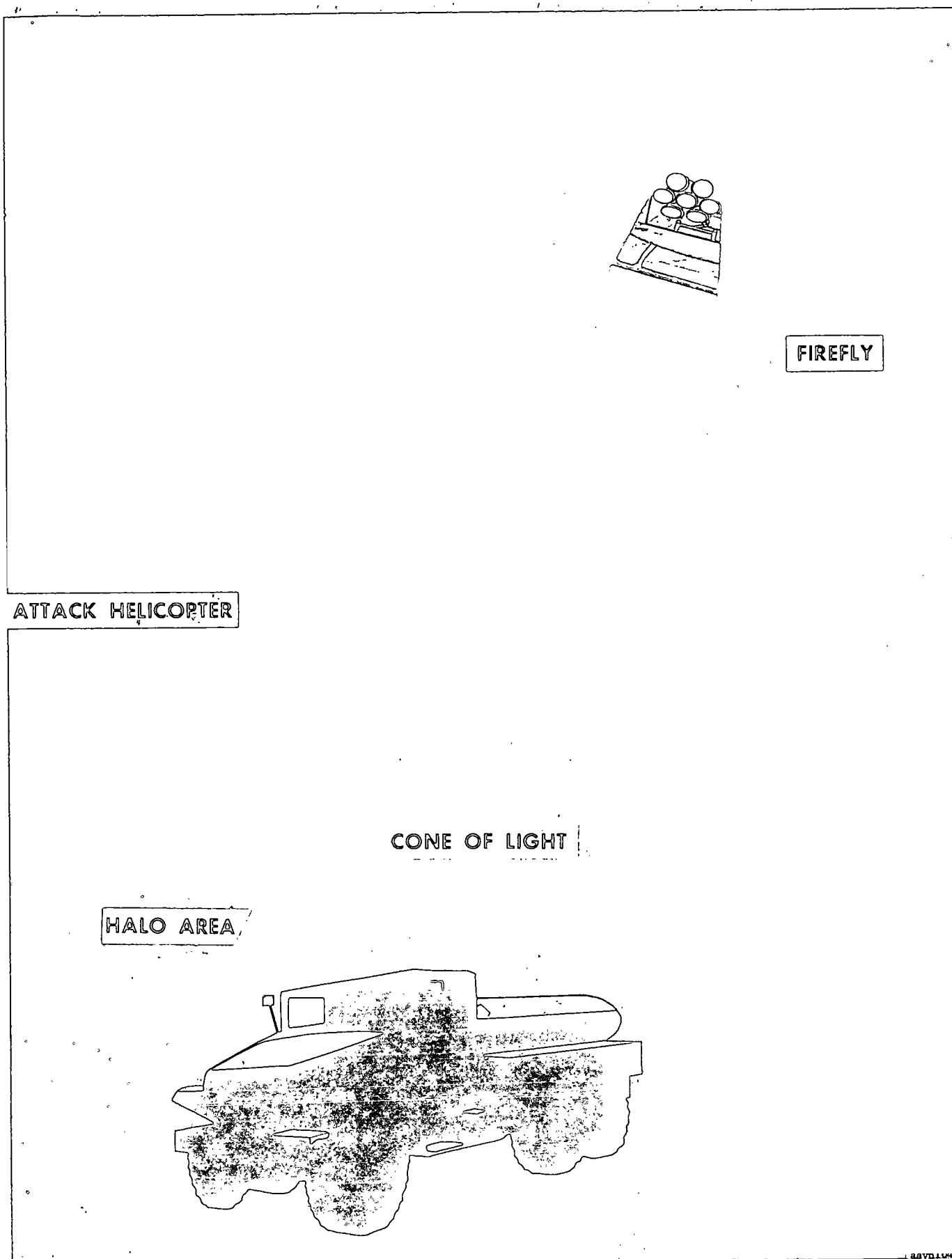


Figure 3-2. Firefly.

c. Infrared and Light Amplification Systems. Infrared, sniper scope, and LLLTV light amplification systems can be used effectively to locate targets. However, the sensitivity of these systems to light normally prevents their use for actual target attacks.

(1) Normally one helicopter equipped with a light amplification system precedes a fire team.

(2) To provide the necessary protection from

hostile ground fire, the helicopter with the light amplification system will be either totally blacked out (no external light) or will have only those lights that are visible from above.

(3) Once the target is located and marked by the helicopter carrying the light amplification system, the attack can be initiated in the conventional manner using either natural or other artificial illumination.

CHAPTER 4

SIGHTING AND ENGAGEMENT TECHNIQUES

Section I. SIGHTING TECHNIQUES

4-1. Introduction

Due to the maneuverability of the helicopter and the wide variety of target situations, the helicopter crew must have a thorough knowledge of their capabilities and limitations with their respective weapons systems. The techniques of engaging targets depends upon the weapons system being used. Basically, these systems can be broken into two groups: *fixed systems* (i.e., rockets and fixed/stowed guns) and *flexible systems*.

4-2. Special Considerations

a. Parallax. Parallax is the apparent displacement of an object due to a change in viewpoint. It is caused by a misalignment of the lens and can result in serious errors in gunnery. For a gunner, parallax is present in a reflex infinity sight when a change in his head position moves the pipper from the target. If the sight is free of a parallax error, the pipper will remain on the aiming point regardless of the gunner's head position.

b. Adjusting Tracer Fire. It is advisable to sight with both eyes when adjusting tracer fire because the gunner has better depth perception and is better able to acquire and adjust the tracer fire onto the target. This is especially desirable when firing at targets at greater or shorter ranges than boresight range.

c. Spatial Disorientation (Vertigo). This subjective lack (or disturbance) of equilibrium is caused by a discord of sensations coming to the brain from the eye and the internal ear. This sensation can occur while flying under instrument conditions or while changing attention from inside to outside the cockpit (such as navigating from a map). Vertigo can be induced by rotor movement, anticollision light reflections, sudden flashes of light, etc. Night vertigo is of primary importance to attack helicopter crewmembers. Due to the steep dive angles and sharp turns incurred in helicopter attacks and the possible resulting loss of equilibrium, it is advisable for either the pilot or copilot to monitor the instru-

ments during target attacks at night. In this manner, the symptoms of vertigo are easily recognized and positive control of the helicopter can be assumed by the crewmember not affected. For a further discussion of vertigo, see TM 1-215.

d. Target Fixation. Target fixation is a condition found most often in inexperienced aviators intent on destroying a given target. It results in the loss of appreciation for speed, rate of closure, altitude, and other external stimuli. This condition can normally be avoided by practicing constant division of attention, even during target attacks.

4-3. Boresighting

Boresighting is the process by which the optical axes of the sight are made parallel (vertically and horizontally) to the boreline axis of the weapon. Depending upon availability of tools, type of weapon, etc., two methods are prescribed for boresighting each subsystem. These methods are the *distant aiming point* and the *parallel line*. For the step-by-step procedure, see the appropriate armament subsystem 9-series TM (app A).

a. Distant Aiming Point. A common point is selected at a relatively great distance (preferably infinity) to which the longitudinal axis of the helicopter, the sight, and the weapons are aligned. If the aiming point is selected at less than infinity, the axis of each weapon will converge at the aiming point.

b. Parallel Line. This method usually uses a sighting board which is aligned with the helicopter. Then the sight and the weapons are aligned with measured points on the sighting board. In this method, the axes of the weapons do not converge.

4-4. Harmonization

Harmonization is the process of aligning the sight to the weapon boresight so that the rounds impact the target at a given range. This is accomplished by aligning the sight, the weapons, or both, using

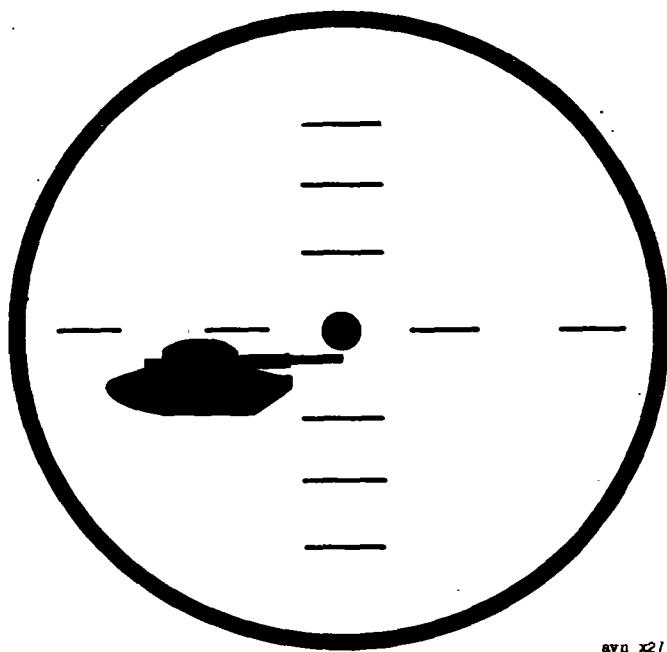


Figure 4-1. Combat sight method—corrected for a crosswind from the right.

the “burst-on-target” method. For the step-by-step procedures for harmonizing the various weapons, see the appropriate armament subsystem 9-series TM (app A).

4-5. Sighting Techniques

a. Fixed Systems. The techniques required to fire aerial rockets are more restrictive than those for firing fixed/stowed guns; therefore, this discussion will be limited to rocketry. The same techniques will insure accurate fire with fixed/stowed guns. Aerial rockets are affected by many variables (such as crosswind, relative wind, and flight coordination). To reduce the adverse effect of these variables on rocket accuracy, two methods of sighting were developed. These sighting methods are the *pipper intersection* and the *combat sight*.

(1) *Pipper intersection method.* The pipper intersection method provides sight settings for various altitudes. However, this method requires altitude, airspeed, and range to be determined prior to launch. Generally these conditions are known only for preplanned fires (preparation, etc) and require precise timing. Even though the pipper intersection method allows for some variation in altitude, this method seriously restricts maneuver and is normally unacceptable for most mission profiles. To use the pipper intersection method, the aviator must—

(a) Select the airspeed and range from which he will fire.

(b) Apply the elevation setting for selected altitude and airspeed (table 4-1) to the sight elevation/depression knob.

(c) Fly the helicopter at the preselected altitude and airspeed.

(d) When the pipper is on the target, fire the rockets.

(2) *Combat sight method.* The combat sight method is the most widely used and gives the desired accuracy and timeliness over the widest variety of mission profiles. It requires very little mathematical or manual manipulation, either of which is distracting during target attack; and, by using a single sight setting, it allows engagement of targets over widely varying ranges without adjustment of the sight. It does require that offset correction (“Kentucky Windage”) be applied for both range and wind conditions (fig 4-1). The requirements for using the combat sight method are that—

(a) The helicopter must be in coordinated flight (horizontal and vertical trim).

Table 4-1. Elevation Setting for Pipper Intersection Method

Altitude (feet)	Indicated airspeed (knots)	Horizontal range (meters)	Sight setting (degrees)
30	100	750	+2.8
	90	750	+1.8
	80	825	+0.7
	70	1,700	+0.2
	60	1,850	-0.2
	50	2,150	-0.8
	40	2,300	-1.4
100	100	1,100	+3.5
	90	1,400	+2.3
	80	1,600	+1.5
	70	1,900	-0.2
	60	2,250	-1.7
200	100	1,350	+2.6
	90	1,550	+2.2
	80	2,100	+1.9
	70	2,250	+1.5
300	100	1,950	+4.7
	90	2,100	+2.8
	80	2,200	+1.2

(b) The range be estimated within 100 meters.

(c) The proper amount of offset correction be applied.

b. Flexible Systems. The sighting techniques for flexible weapons systems are similar to those for fixed systems. However, specific weapons, sights, and sight displays will differ with weapons having high and low muzzle velocity.

(1) *High muzzle velocity.* Weapons with a

high muzzle velocity have a relatively flat trajectory and are not affected by those ballistic factors associated with flexible weapons (chap 2) as much as low muzzle velocity weapons. This, in combination with the high rate of fire of flexible systems, eliminates the requirement for mil values on the sight reticle image. The procedures given below should be followed:

(a) Harmonize these weapons at their maximum effective range. Maximum effective range is dependent upon tracer burnout, volume of fire, and type of sight.

(b) Place the pipper on the target. Fire and observe tracer impact. Adjust weapons so tracers impact on the target. Due to the high volume of fire and the relatively simple sighting techniques, fire from this type of weapon is relatively accurate.

(2) *Low muzzle velocity.* Weapons systems with a low muzzle velocity (less than 2,000 fps) have a relatively higher angle of fire and are affected considerably by the ballistic factors discussed in chapter 2. These weapons have a relatively slow rate of fire and may not have a tracer element. Sights for these systems require mil value/range lines and/or a complex lead-compensating sighting system. These systems are boresighted for one altitude and airspeed, and offset

correction is required if these conditions are not met. For example, current M5 40mm subsystems are boresighted for 90 knots airspeed, 100 feet absolute altitude, and 700 meters range. As absolute altitude or airspeed is increased, the gunner must decrease range settings on the sight (aim short of the target). The same correction applies conversely: as absolute altitude or airspeed is decreased, the gunner must increase range settings on the sight (aim over the target). Deflection shots at other than boresight altitude and airspeed are very difficult as the lead and lag values are not easily determined. When employing this system, accurate range estimation is required, coupled with accurate application of lead or lag values. Due to the longer time-of-flight of the rounds, it is usually not possible to "walk" the rounds onto the target. Proper sighting techniques for this type system are to—

(a) Estimate range and altitude above the target and note airspeed.

(b) Apply factors for these conditions to the sight, including lead for deflection.

(c) Fire a short burst and note the impact.

(d) Make sighting adjustments on succeeding bursts, compensating for range closure.

Note. For the gunner to be accurate with low muzzle velocity weapons, sighting techniques require considerable training.

Section II. ENGAGEMENT TECHNIQUES

Note. Since the technique for engaging targets using the *pipper intersection* method is seldom used, only the *combat sight* method is discussed below.

4-6. Establishing the Combat Sight

To better understand why the combat sight method of engaging targets is more widely used than other methods, it is helpful to understand the procedure for establishing the combat sight. Following is an example using the combat sight with the 2.75-inch FFAR; it is equally applicable to any fixed fire system.

a. Boresight the system in accordance with chapter 11.

b. For UH-1B/C/M helicopters, select a target at 1,250 meters slant range. For AH-1G helicopters, select a target at 1,500 meters slant range. These ranges are one-half the maximum effective ranges of the weapons; however, the selected range will be that range from which the majority of all targets is engaged. This selected range may be made according to individual preference or unit SOP.

c. At a tactical altitude and airspeed and with the pipper on the target, fire one or more rounds. Note the impact of the round or rounds and rotate the knurled ring (elevation-depression) to put the *pipper on the burst*.

d. Repeat step c until the rounds are consistently hitting on the pipper. Usually three rounds (or three pairs) will be sufficient to obtain the combat sight setting. This setting may be established at any range. Midrange allows the widest possible latitude for engaging targets. Using this method, targets may be engaged from 300 meters (minimum safe slant range) to 2,500 meters for UH-1B/C/M helicopters and 3,000 meters for AH-1G helicopters (maximum effective ranges), and the proper sight setting will still fall within the sight reticle (80 mils for the XM60 sight; $\pm$ 125 mils for the XM73 sight).

Note. The combat sight setting for machineguns is normally accomplished at slightly less than maximum effective range. Targets beyond maximum effective range may be engaged with an acceptable dispersion pattern. This is accomplished by adjusting the fire so that tracer burnout appears to occur just above the target.

4-7. Using the Combat Sight Setting

a. At the altitude and airspeed chosen for obtaining the setting, the rounds will impact at the pipper at the selected range. Therefore, it is necessary to use this altitude, airspeed, and range, or to compensate for any changes. Changes in range are accomplished by aiming 4 mils high for each 100 meters beyond the range chosen for the setting, and 4 mils low for each 100 meters less (fig 4-2). If the combat sight setting is made at 1,250 meters for UH-1B/C/M helicopters, the proper setting required to engage a target at 2,500 meters is to hold the pipper at 50 mils ($4 \times 12.5 = 50$) above the target. If the combat sight setting is made at 1,500 meters for AH-1G helicopters, the proper setting required to engage a target at 3,000 meters is to hold the pipper at 60 mils ($4 \times 15 = 60$) above the target. If the target is at 300 meters for UH-1B/C/M helicopters, hold the pipper at 38 mils ($4 \times 9.5 = 38$) below the target. If the target is at 300 meters for AH-1G helicopters, hold the pipper at 48 mils ($4 \times 12 = 48$) below the target.

b. Once an entry altitude and airspeed have been selected, a constant power setting must be maintained and the same selected entry altitude and airspeed used in each pass at the target. For example, if the setting were obtained using 91 percent N_1 (gas producer speed) in the helicopter, this setting would result in nearly the same trajectory every time if the helicopter weight remains relatively constant.

c. Considering the factors in *a* and *b* above, one way to use the combat sight setting is to—

- (1) Initiate the roll-in on the target run.
- (2) Check the power setting and helicopter trim and adjust as necessary to maintain a trim condition.
- (3) Estimate the slant range to the target and apply the compensation factors.
- (4) Obtain the proper sight picture by flying the helicopter using only the cyclic control stick.
- (5) While the helicopter is in its most stable flight, fire as soon as the proper sight picture is obtained. The helicopter becomes more unstable as the dive progresses and airspeed builds up.
- (6) Use "burst on target" for subsequent adjustments.

4-8. Slant Range Estimation

Slant range (fig 2-13) applies to aerial weapons systems. It is the distance along the line of sight

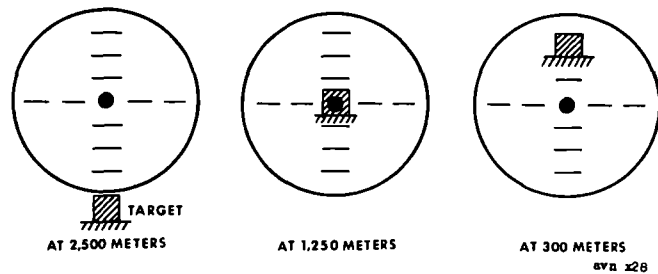


Figure 4-2. Using the combat sight setting.

from the weapon to the target. At the altitude and attack angles used by attack helicopters, slant range is slightly greater than horizontal distance to the target. The methods of determining slant range are *estimation by eye*, *sight mil values*, *tracer burnout*, and *maps and photomaps*.

a. *Estimation by Eye*. The most common method used for determining range is estimation by eye. Normally this method is most accurate when the range is compared to known ranges, i.e., the number of 100-meter segments there are in the range. While this method is the most rapid, it is also the least accurate. Some reasons for this inherent inaccuracy are—

- (1) *Nature of the target.*
 - (a) A target in contrast to its background appears closer.
 - (b) A target that blends with its background appears more distant.
 - (c) A target that is partially hidden appears more distant.
- (2) *Nature of the terrain.*
 - (a) Over smooth terrain, the eye tends to underestimate the range.
 - (b) Over rough terrain, the eye tends to overestimate the range.
- (3) *Visibility.*
 - (a) A target seen in full sunlight appears closer than one observed through haze or fog.
 - (b) When the sun is behind the target, the target appears more distant than it actually is. When the sun is behind the observer, the target appears closer.

b. *Sight Mil Values*. Because of sight vibration caused by aircraft flight, reading the mil values of target width in the sight is difficult or sometimes impossible. However, if this value can be found and the actual target width is known, the mil value for target width can easily be converted to the range. At a range of 1,000 meters, 1 mil equals 1 meter; therefore, if target width is known, range can be found by using the following formula—

$$R = \frac{W}{m} \times 1,000 \text{ meters}$$

where:

R = range (meters)

W = known target width (meters)

m = mil value of target width (meters)

For example, a tank known to be 15 meters long covers 20 mils of reticle width (fig 4-3)—

$$R = \frac{15 \text{ meters}}{20 \text{ mils (meters)}} \times 1,000 \text{ meters} = 750 \text{ meters}$$

c. *Tracer Burnout.* Because the 7.62mm (NATO) round of tracer ammunition burns out at a range of approximately 750 meters, the gunner can use tracer burnout to make a range estimate. If the tracers burn out before reaching the target, he can compare the 750 meter tracer burnout distance to the total distance to the target. His range estimate is based on this comparison. For example, the gunner fires a burst of tracer ammunition from his machineguns that burns out halfway to the target. Thus he estimates that the range to the target is 1,500 meters.

d. *Maps and Photomaps.* Prior to the mission, ranges from prominent terrain features to the target area may be determined from maps and photomaps. This permits comparison of actual ranges with ranges estimated by eye and is very useful in teaching aviators to correctly estimate ranges by eye.

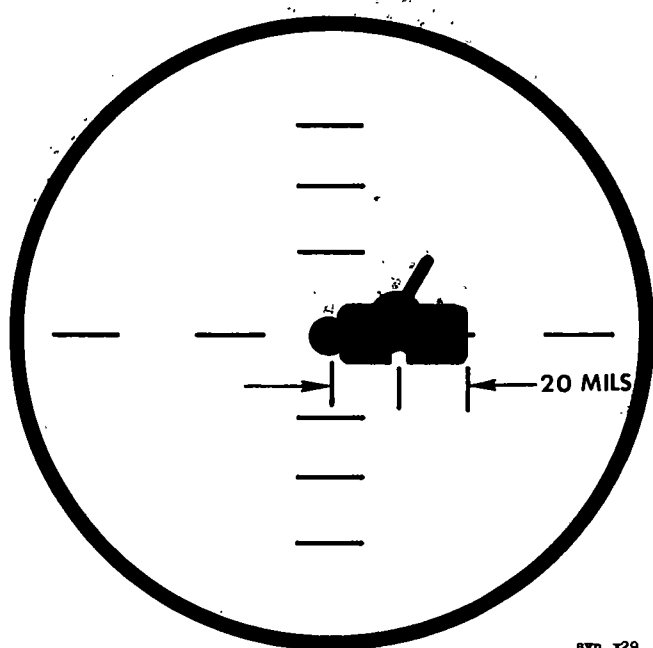


Figure 4-3. Reading sight mil value of target.

4-9. Flight Techniques

Before accuracy with aerial fire weapons can be expected, the aviator must be able to fly the helicopter without actually concentrating on the art of flying. However, to assure weapons accuracy, coordinated flight must be maintained by using smooth control pressures.

Caution: Review of attack helicopter accident statistics revealed that mishaps occurred most frequently from the following conditions:

- (1) Late recovery from steep dive angles causing "mushing."
- (2) Abrupt control movements at the top of the climb-out causing rotor unloading (negative G's).
- (3) Malfunctioning of subsystems causing damage to the airframe and rotor systems due to dirty and corroded tubes and barrels.
- (4) Steep turns at high gross weight conditions causing loss of lift.

a. *Coordination.* Coordinated flight is especially important in aerial rocketry. An "out-of-trim" condition creates unacceptable dispersion in rocket fire (para 2-3b(2)(d)). Emphasis must be placed on flying the helicopter to the proper sight picture rather than using uncoordinated flight to obtain the sight picture. A common tendency is to cross-control, using the antitorque pedals to get the proper sight picture.

b. *Control Touch.* Control touch affects both fixed and flexible firing modes. Since rough and abrupt control movements result in unacceptable dispersion patterns, smooth control pressures must be applied. For most aviators, bracing their right elbow (forearm) on their right thigh allows the proper muscle response for positive smooth control movements. This permits the proper sight picture to be obtained in a much shorter time without the unnecessary movements which result in "chasing the pipper around the target."

4-10. Turning Error

Firing while in a bank affects both fixed and flexible weapons fire. To compensate for ballistic factors, the boreline axes of all weapons systems are elevated above the horizontal. If the weapon is fired while the helicopter is in a bank, this elevation becomes deflection (fig 4-4). Firing results in rounds impacting short and inside the turn. To compensate for turning error, it is necessary to aim high and opposite to the direction of the bank.

4-11. Methods of Attack

The method of attack will be selected by the

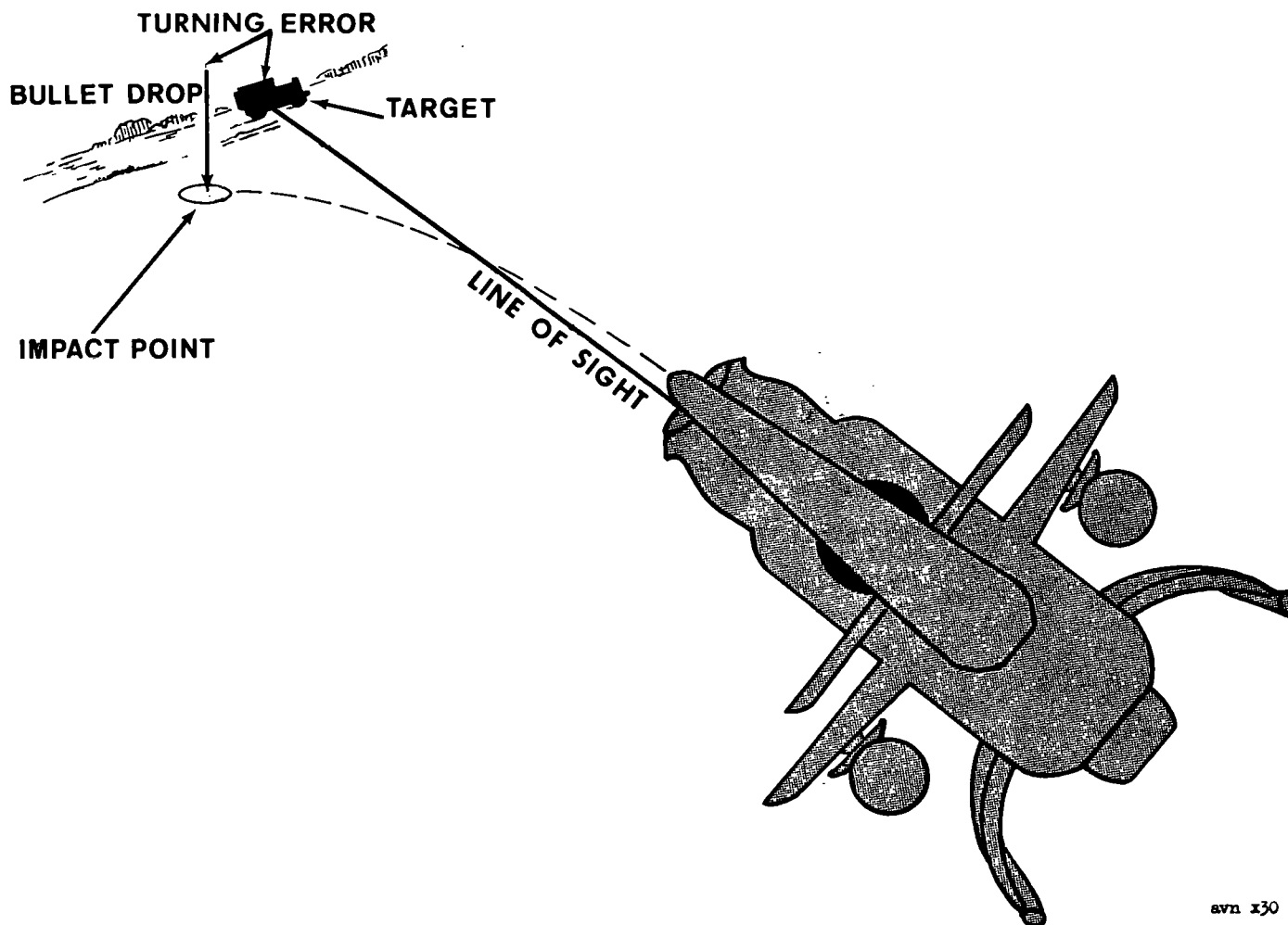


Figure 4-4. Turning error.

attack helicopter mission commander, based upon the factors of METT. Attack helicopters may attack a target by running/diving fire or hovering/slow flight fire.

a. Running/Diving Fire. Running/diving fire is delivered on target while the helicopter is in forward flight. It can be delivered from any altitude, provided the slant range to the target is compatible with the maximum effective range of the weapon. Running fire delivered from the nap-of-the-earth flight mode takes maximum advantage of available cover and concealment. This mode provides fire which is highly effective against troops in the open. Higher flight altitudes during attack will result in diving fire at short slant ranges which also increases the vulnerability of the attacking helicopter. This fire has nearly a point fire accuracy and results in maximum destruction of an enemy in foxholes or trenches. Steeper dive angles also result in higher airspeeds that require initiating the disengagement at

greater ranges to avoid target overflight and abrupt recovery which can result in "mushing." Targets may be engaged from the rear, the flanks, or the front. To preclude enemy anticipation of succeeding firing runs, succeeding passes should be made from different directions.

b. Hovering/Slow Flight Fire. Hovering/slow flight fire is delivered with the attack helicopter in a concealed position. Available concealment must be used during the approach and execution of the fire mission. Where terrain permits, the helicopter should be moved laterally between bursts of fire so that it does not appear to the enemy twice from the same position. Background for the helicopter should be chosen with care to avoid being silhouetted against the sky or light terrain. Fire teams will alternate their attacks in order to place continuous fire on the enemy position. The helicopter is extremely vulnerable when practically motionless over the ground. Firing from a hover does not increase weapons accuracy. With certain weapons

systems (e.g., the 2.75-inch FFAR), a loss of accuracy causes fire from a hover to be less practical. Hovering/slow flight fire may be used when it is necessary to clear a terrain obstacle. Loss of observation, mobility, flexibility, and maneuver must be thoroughly considered by all commanders prior to the employment of attack helicopters in a hovering attack.

4-12. Attack Patterns and Formation

a. General. Normally specific attack patterns cannot be preplanned. However, certain considerations apply to all patterns. The attack helicopter mission commander will adjust each attack to take advantage of the terrain and weather, to exploit enemy weaknesses, and to employ his combat elements to gain the maximum advantage. Important considerations in the selection of an attack pattern include the number of attacking elements, the target characteristics, weapons capabilities, friendly forces in the immediate area, the disposition of enemy defenses, and the requirement for a change in direction of subsequent attack runs. Overflying of friendly positions on target attacks should be avoided as much as possible.

b. Racetrack Pattern. The racetrack pattern (fig 4-5) is the basic attack pattern from which the others are derived. This pattern may be used on any mission or may be modified as the situation dictates.

(1) Advantages.

(a) Any number of helicopters may be used in the pattern.

(b) The helicopters are mutually supporting by fire and observation.

(c) Continuous fire may be placed on the target.

(d) Engagement range, disengagement range, and timing are flexible.

(e) The mission commander has good control over the attack.

(2) Disadvantages.

(a) Target is covered from only one direction at a time.

(b) Enemy is able to place enfilade fire on the entire attack formation from one position.

(c) Only one helicopter can engage the target at a time.

(d) At attack from low altitude, mutual fire support and observation is hard to achieve.

c. Cloverleaf Pattern. The cloverleaf attack pattern (fig 4-6) may be employed during destruction missions against point or small area targets.

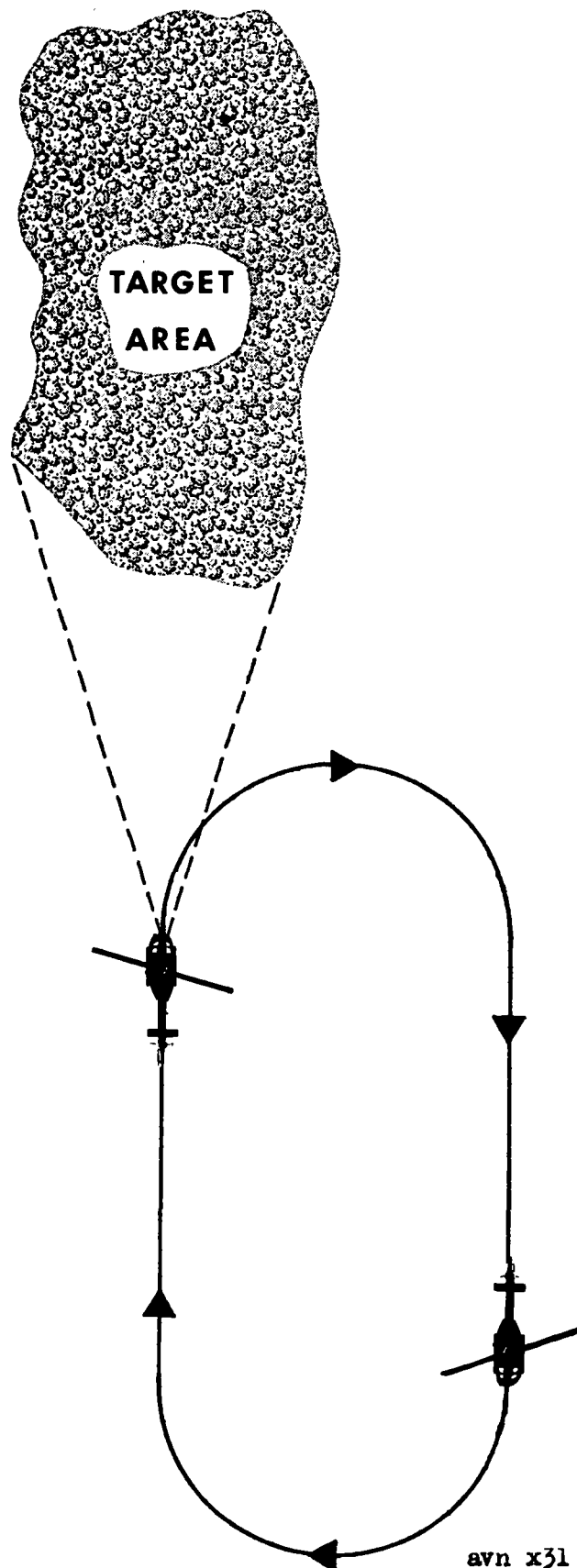
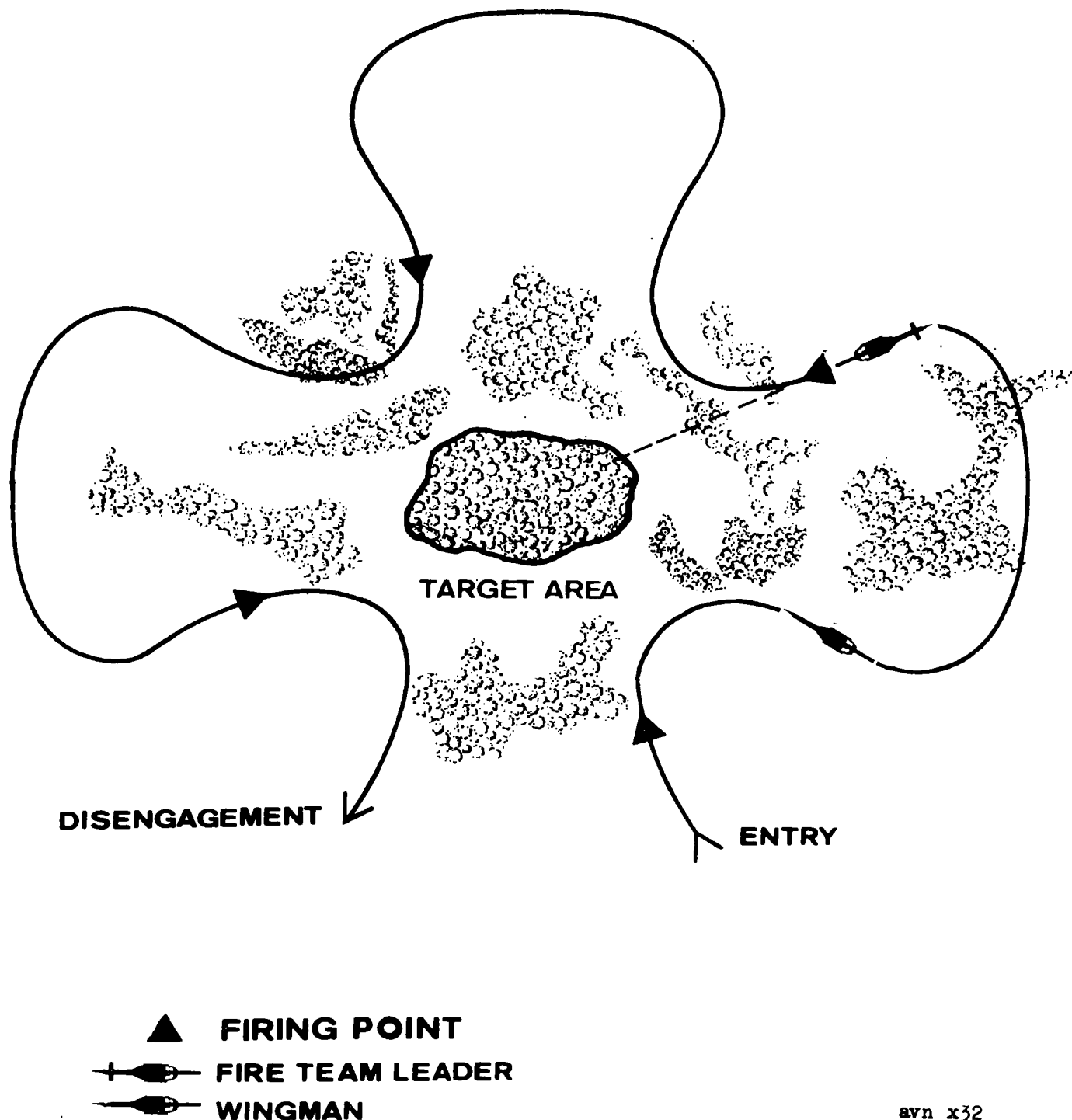


Figure 4-5. Racetrack pattern.



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Figure 4-6. Cloverleaf attack pattern.

(1) Advantages.

(a) Changing direction for each attack prevents enemy concentration of fires in anticipation of subsequent attacks.

(b) Good target coverage from several directions requires enemy defenses to be constructed for all-around protection.

(c) By placing continuous fire on the target, this attack prevents enemy movement to reposition forces.

(d) Engagement range, disengagement range, and timing of attack are flexible.

(e) Attacking helicopters are mutually supporting, and the mission commander can maintain control of the attack.

(f) The pattern may be modified to adapt to the terrain and the number of firing passes required.

(g) Initial entry and the attack pass can be established at any point.

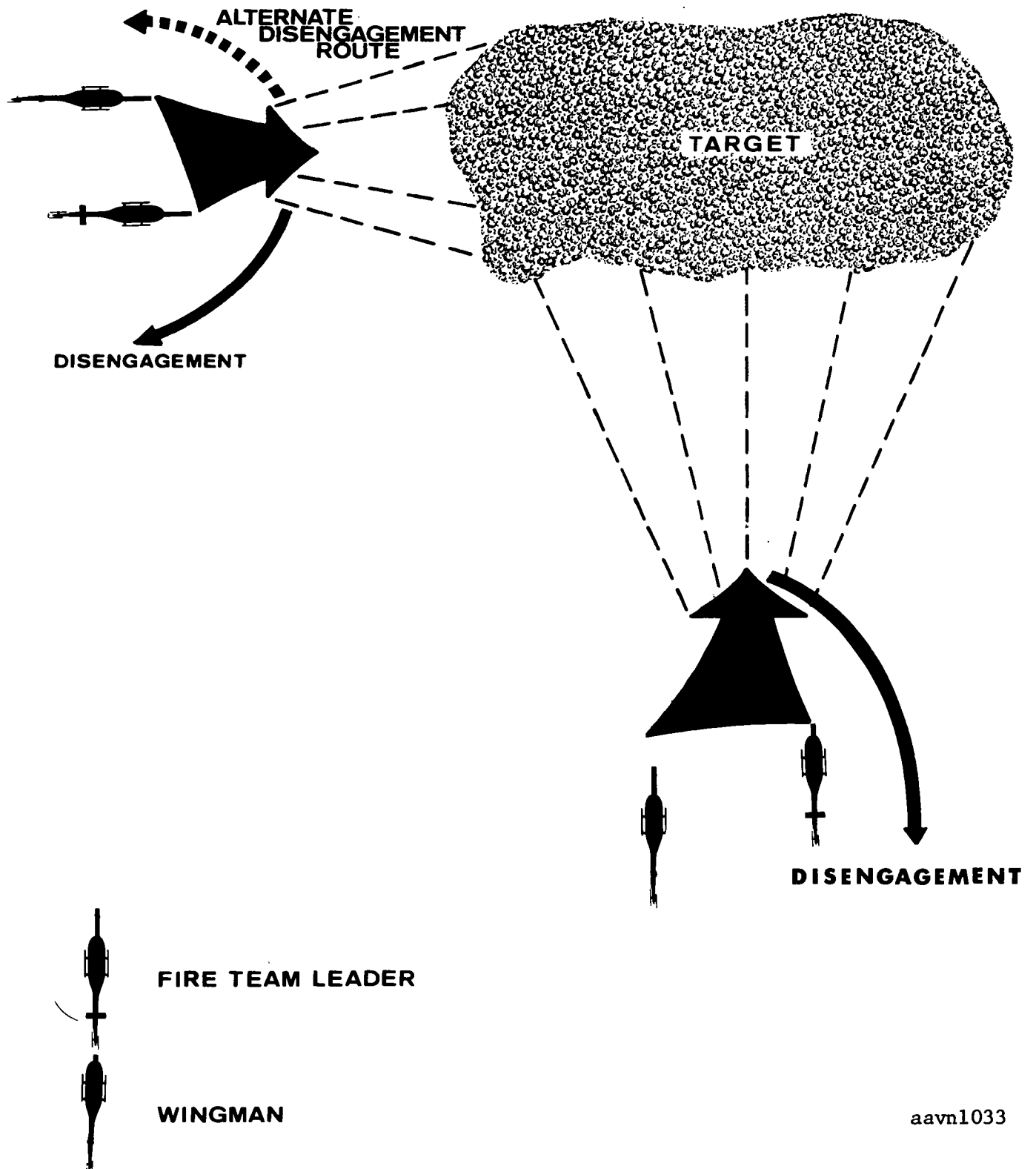


Figure 4-7. L attack pattern.

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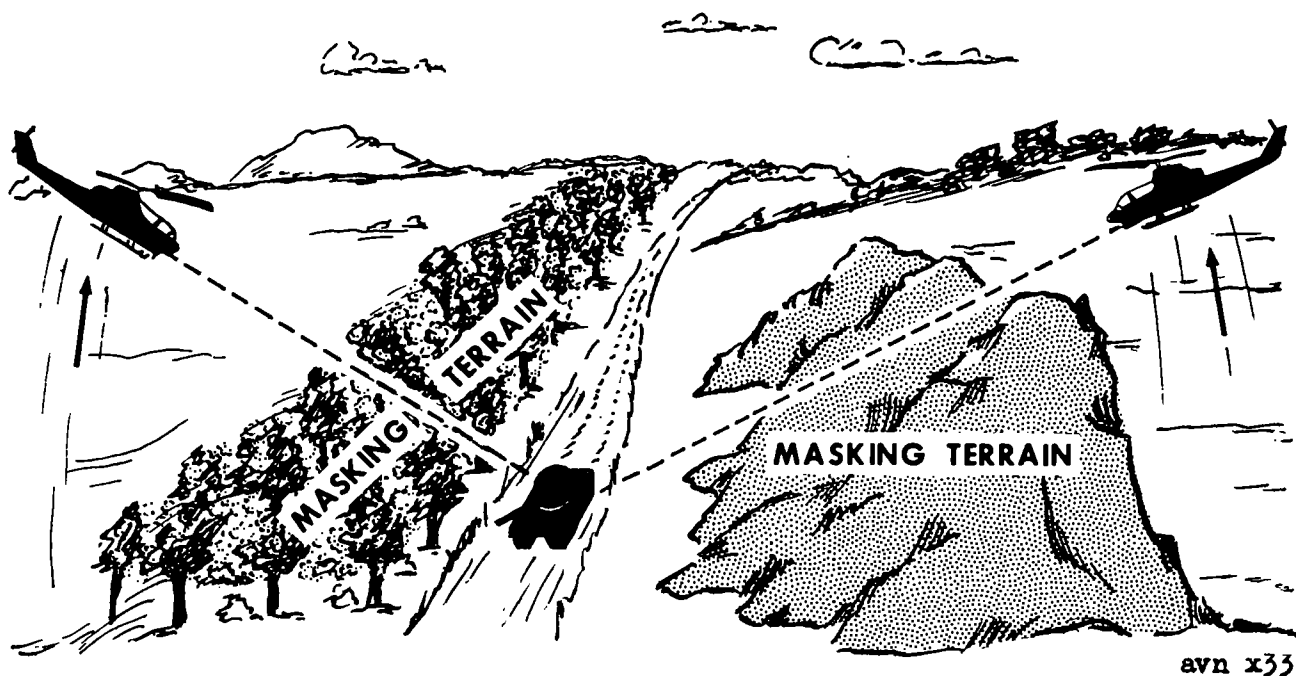


Figure 4-8. Mask/cresting hover attack pattern.

(2) *Disadvantages.*

- (a) Hostile areas may be overflowed.
- (b) Care must be exercised not to fire into adjacent friendly positions.
- (c) The number of helicopters that can be effectively used in the pattern is limited.
- (d) Control is difficult.

d. L Pattern. The L attack pattern (fig 4-7) is most effective against targets requiring a large volume of fire for a short duration; therefore, this pattern is ideal for destruction of point targets. The L pattern is also excellent for attacking linear targets or targets which are masked on one side by high terrain. If a large volume of fire is not required, proper timing allows one helicopter at a time to fire neutralization fire for a sustained period.

(1) *Advantages.*

- (a) The enemy is fixed during the period of maximum fire delivery.
- (b) Surprise and speed of attack limit exposure of the helicopter to return fire for minimum periods of time.
- (c) Good target coverage is obtained from two directions simultaneously.
- (d) The beaten zone of at least one attacking element will generally correspond to the long axis of the target.
- (e) The enemy is forced to defend in two directions simultaneously.

(f) Maximum engagement and minimum disengagement ranges are allowed by this pattern.

(g) Use of reference points makes timing precise.

(2) *Disadvantages.*

- (a) Control, timing, and formations are critical.
- (b) Care must be exercised not to fire into (or over the heads of) adjacent friendly units.

e. Mask/Cresting Pattern. The mask/cresting hover attack pattern (fig 4-8) is used when a high concentration of radar and antiaircraft fire is prevalent. Between engagements, attack helicopters move to different positions.

(1) *Advantages.*

- (a) Attacking helicopters are mutually supporting.
- (b) Surprise and firepower are attained on initial assault.
- (c) Enemy target acquisition of attacking helicopters is at a minimum.
- (d) Good target coverage.
- (e) Enemy is forced to defend in more than one direction at the same time.
- (f) As many helicopters as desired may be used.

(2) *Disadvantages.*

- (a) Weather (e.g., density altitude, wind) has a great effect on hovering helicopters.
- (b) The mask/cresting hover pattern is difficult to use at night.

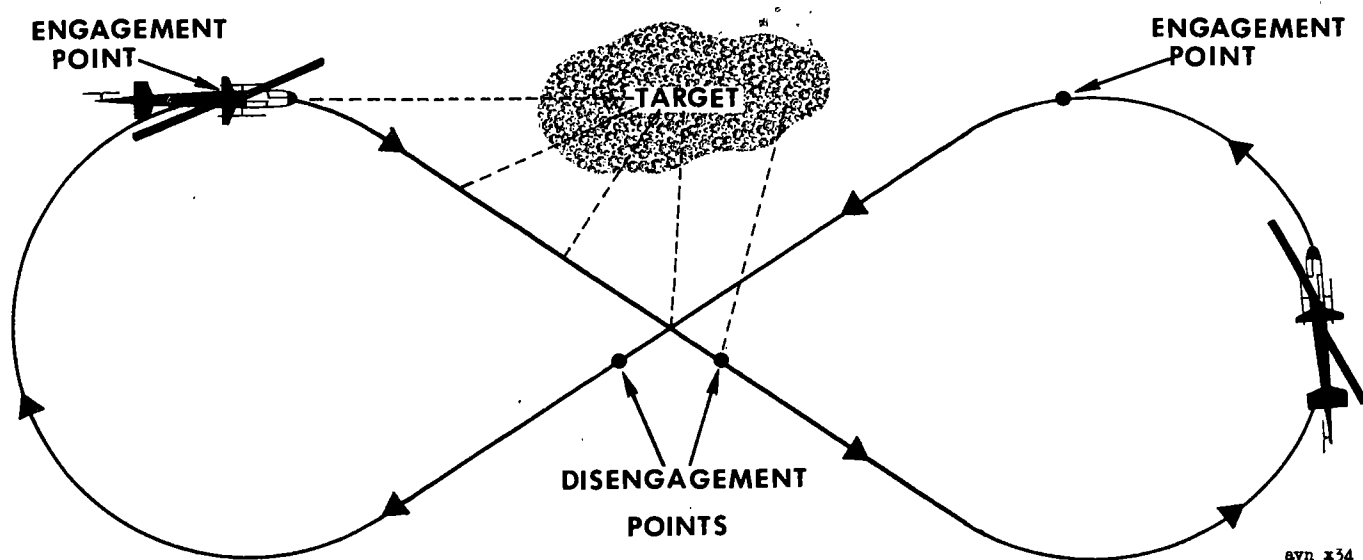


Figure 4-9. Figure-eight attack pattern.

(c) There is a high probability of main and tail blade strike.

(d) Helicopters are very vulnerable to small arms weapons.

(e) Mechanical emergency situations become more critical.

(f) Helicopter operating limitations must be considered at a hover. See the appropriate TM 55-series-10 aircraft operator's manual.

f. Figure-Eight Pattern. The figure-eight attack pattern (fig 4-9) can successfully be used against almost any type of area, linear, or point target.

(1) *Advantages.*

(a) Good target coverage is obtained from two directions.

(b) Long axis of the beaten zone can be placed along the long axis of the target.

(c) Attacking helicopters are mutually supporting by both fire and observation.

(d) Continuous fire can be placed on the target area.

(e) Disengagement is not as abrupt as in other attack patterns and effective fire can be placed on the target area throughout the break.

(f) Engagement and disengagement range is flexible.

(2) *Disadvantages.*

(a) Control, timing, and formations are critical.

(b) Only one helicopter can engage the target at a time.

(c) Care must be exercised not to fire into adjacent friendly positions.

(d) Control element may be necessary.



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CHAPTER 5

FIRE COMMANDS AND EXECUTION

5-1. General

Fire commands allow the aircraft commander to begin, conduct, and end all aerial fires. The timely and accurate fires of the team are dependent upon complete understanding of commands by every member in the team.

5-2. Fire Command Sequence

To insure complete understanding, the elements of the fire command are given in the following sequence:

Se- quence number	Element of command	Example (Aerial Field Arty)
1	Identification and warning order.	"Dragon 34 this is Dragon 33; fire mission * * *."
2	Reply-----	"This is Dragon 34; send your mission * * *."
3	Target location and description.	"At my 10 o'clock, troops dug in."
4	Attack direction-----	"From NE to SW (225°)."
5	Direction of break-----	"Break left."
6	Attack formation-----	"Racetrack" (when applicable).
7	Weapons to use-----	"Rockets only."
8	Amount to expend-----	"Expend five-zero percent (one-half)."
9	Special restrictions-----	"Keep all fires north of canal line."
10	Acknowledgement-----	"This is Dragon 34, Roger."

5-3. Elements of Fire Command

Paragraphs 5-4 through 5-13 below explain each element of the fire command. Some of the elements listed are used only under special circumstances and are not announced when they have no application. When the attack requires more than one firing pass, an abbreviated command should be given for each pass.

5-4. Identification and Warning Order

During the course of any mission, several radio transmissions will pass from fire team leader to

wingman. The words "Fire mission" warn the wingman that this transmission is of the highest priority and requires his fullest attention. This transmission will normally not be required on subsequent firing passes during the same attack.

5-5. Reply

The wingman replies so that the fire team leader knows he is alerted and ready to receive the mission. Reply is not required unless a *warning* is given.

5-6. Target Location and Description

This element of the command should be as concise as possible but not so concise as to preclude absolute understanding of the target and its location by all members of the team.

a. Location. Target location, especially in situations where the target is obscure, is perhaps the most important element of the command. An accurate description of the target location is necessary to insure that the first rounds are close to the target. During daylight hours, location may be described by grid coordinates, polar coordinates, or by adjusting from previous rounds or smoke. During night operation, location may be facilitated by using artificial illumination.

b. Description. To prevent engaging the wrong target, the target description must be clear and stated in terms understood by all. Target description normally will provide the basis for weapon selection.

5-7. Attack Direction

When the fire team leader specifies the attack direction, he allows the wingman time to move into position to provide protective fires as well as prepare for his firing pass on the target. When determining the attack heading, the fire team leader considers the guidelines for employment (chap 7). Attack direction or heading is given in general terms (i.e., northwest, southeast, north, south, etc.) to allow the wingman the widest possible latitude in order to provide protective fires

for the leader and still be in position to initiate his firing pass. This element of the command will usually be required for each subsequent pass.

5-8. Attack Formation

To position each helicopter in the fire team at the proper location during the attack, the formation to be used in the attack will be given in the fire command. For attack patterns and attack formations, see paragraph 4-12. Unless changed, this element of the command need not be repeated for subsequent passes.

5-9. Weapons To Use

This element of the fire command is used by the fire team leader to control the type of fire delivered on the target. Unless specified otherwise, it applies only to those weapons to be used on the target. Weapons for self-protection, such as machineguns and automatic weapons, may be employed at the discretion of each aircraft commander to protect himself, regardless of the weapons used on the target. This element of the command will usually be required for each firing pass.

5-10. Amount of Ammunition to Expend

The fire team leader uses this element to control the *maximum* amount of ammunition that will be expended on the target. Of the total amount of ammunition specified, only the amount sufficient to obtain the desired results is expended. Normally, this element of the fire command applies only to that ammunition to be used on the target.

Each aircraft commander is responsible to control any countermeasure fire required for self-protection during the firing pass.

5-11. Direction of Break

The fire team leader calls the direction of break so that the wingman can position himself to take advantage of the break. For example, if the break is to the left, the wingman will normally be on the leader's right side so that he can commence his firing pass as soon as the leader breaks without having to wait while the leader clears his line of fire. The direction of break will be governed by those principles of target attack discussed in chapter 7, and will be required for each fire command.

5-12. Special Restrictions

The fire team leader uses the ninth element to limit the identification and warning order (para 5-4) with special restrictions that may apply. For example, attack helicopter fires will be directed away from areas occupied by friendly troops.

5-13. Acknowledgement

All aircraft commanders of the attack helicopter team must "Roger" the fire command to signify that they have received and understand the transmission. If any portion of the fire command is not understood, the recipient should request a clarification (i.e., "Say again, direction of break"). All subsequent fire commands must be acknowledged by each helicopter.

CHAPTER 6

CALLS FOR FIRE AND FIRE ADJUSTMENT

Section I. CALLS FOR FIRE

6-1. Command and Control

To fully exploit the advantages of the versatile attack helicopter weapons system, attack helicopter command and control must be simple and direct. Attack helicopters organic to an aerial field artillery unit are normally requested through fire support channels. Other attack helicopter support (e.g., cavalry squadron or separate company assets) is normally requested through command channels. However, when the attack helicopters are acting in an aerial escort role at the time of request for direct aerial fires, the force commander establishes direct communications with the attack helicopter team leader and assigns the mission. The initial requestor, who is located in the combat area where the target has appeared, then advises the attack helicopter commander in the actual execution of the aerial attack. This insures that the requested direct aerial fires are available in the minimum amount of time and also provides the supported force commander with immediate control of a direct aerial fire support system that can be integrated closely with the overall fire support effort.

6-2. Standardization of Terminology

Many military operations involve forces of Allied Nations. Therefore, the sequence and terminology used in calls for fire have been standardized among Allied Nations so that an observer may call for and adjust the fires of another nation's artillery. For example, *azimuth* is stated as *direction* and *coordinates* are stated as *grid*. English is the principal language used in aviation, and a generally accepted terminology has been developed. Examples will be evident in succeeding paragraphs; however, sequence and terminology used in calls for fire for attack helicopters closely parallel the cannon artillery call for fire and adjustment procedures.

6-3. Transmission of Calls for Fire

When an observer has determined the location of

a target that he wishes to engage with attack helicopters, he transmits a call for fire through the request channels as outlined in FM 100-26. A call for fire is a concise message prepared by an individual containing all of the information needed to process his request and to get attack helicopter or another means of fire support to engage the target. The format conforms to the existing cannon call for fire (FM 6-40) and keeps transmissions to a minimum. It also provides for the substitution of attack helicopter fire for cannon field artillery if cannon field artillery is not available, or for the interim engagement of the target by cannon artillery while the attack helicopters are en route to the target. This format also provides for the substitution of cannon support or for the simultaneous employment of cannon artillery and attack helicopters. Prior to departing on any mission, the aircraft commander or fire team leader will normally be responsible for obtaining the frequencies and call signs of available firepower from the unit operations section.

6-4. Elements and Sequence of Call for Fire Format

Following are the six elements of the standard call for fire in the sequence in which they are transmitted:

- a. *Observer Identification.*
- b. *Warning Order* (request for aerial field artillery or attack helicopters).
- c. *Location of Target.*
- d. *Description of Target.*
- e. *Method of Engagement.*
- f. *Method of Fire and Control.*
- g. *Radio Frequency and Call Sign* (encoded if necessary) for *helicopter flight leader to contact.*

6-5. Observer Identification

The observer identification element consists of ap-

propriate call signs or codes necessary to establish contact between the observer, the unit FDC, the fire support coordinator (FSCoord), and the helicopter flight leader. For example the observer transmits, "REDLEG 18 (call sign of FDC), THIS IS REDLEG 24 (call sign of the observer)."

6-6. Warning Order

a. The element warning order is the notice sent by the observer to achieve communications priority and to alert the fire direction center (FDC), the FSCoord, or the S3, of an impending request for fire. The warning order is announced as "FIRE MISSION."

b. The observer may indicate his desire for a particular type of fire support following the warning order. For direct aerial fire support, he states "ATTACK HELICOPTERS"; e.g. "FIRE MISSION, ATTACK HELICOPTERS." If he desires both direct and aerial fire support and cannons, he states, "FIRE MISSION, ATTACK HELICOPTERS AND CANNONS."

c. Following the warning order, the observer may indicate the size of the fire unit desired in fire for effect. For example, "FIRE MISSION, ATTACK HELICOPTERS, PLATOON" indicates that the observer desires attack helicopters to engage the target with a platoon of attack helicopters in fire for effect.

6-7. Location of Target

a. *General.* Normally while en route or over the target area, attack helicopter crews are briefed on the precise location of the target and nearby friendly troops. The location of the target contains two or more elements, depending on the manner in which it is reported by the observer. The initial call for fire should indicate the location of the target by grid reference or reference to a known point. Because of the large area over which attack helicopters operate, the hundred-thousand meter grid designators should always be included; e.g., "GRID XS 679685." One element which is always required in the call for fire by the ground observer is the reference line (direction). This element of direction in his initial request for attack helicopters is required in order that the FDC can be prepared to engage the target with cannon artillery, should attack helicopters not be available, or as an interim engagement while attack helicopters are en route to the target area. When possible, direction will be given in mils for compatibility with cannon artillery and in degrees

for attack helicopters. Without direction being given, the FDC cannot change observer subsequent adjustments into usable FDC data. If a mil/degree conversion scale is not available, this formula should be used: $\text{degrees} \times 17.8 = \text{mils}$.

b. *By Grid Coordinates.* When a target is located by grid coordinates, the elements of the target location are transmitted in the following manner:

(1) *Grid coordinates:* "ND 679 976."

(2) *Grid azimuth from observer to target:* "DIRECTION 1640 MILS (92 degrees)."

c. *By a Shift From a Known Point.* When a target is to be located by a shift from a known point, the elements of the target location are transmitted in the following sequence:

(1) *Known point:* "FROM TARGET AF 2011."

(2) *Observer-target azimuth:* DIRECTION 3600 MILS (200 DEGREES).

(3) *Lateral shift (if any):* "RIGHT (LEFT) 200."

(4) *Range shift (if any):* "ADD (DROP) 50."

(5) *Vertical shift (if any):* "UP (DOWN) 20." Vertical shift is not used by attack helicopters, but is required for cannons.

(6) *Exception:* If there is no shift in a particular dimension, that element is omitted; e.g., "FROM REGISTRATION POINT A, DIRECTION 800 (45 degrees), RIGHT 400, UP 40, or FROM TARGET AF 2020, DIRECTION 4800 (270 degrees), ADD 400, UP 20."

d. *By a Target Number or a Known Point.* The target number and known point are locations which are known to the FDC and to the observer. If a known point is to be fired on, the target location would be reported as—

(1) "FROM REGISTRATION POINT 2, DIRECTION 3200 (180 degrees)."

(2) "TARGET AF 2020, DIRECTION 800 (45 degrees)."

e. *By Polar Coordinates.* When the location of a target is reported by polar coordinates, the elements of the target location are transmitted in the following sequence:

(1) *Observer-target azimuth:* "DIRECTION 1600 (90 degrees)."

(2) *Observer-target distance:* "DISTANCE 2500."

(3) *Vertical shift (if any):* "UP 50."

Note. Regardless of the method used by the observer to locate the target, the FDC will convert the information to

usable data for cannon artillery or attack helicopters as directed by the FSCoord or S3.

6-8. Description of Target

The element indicating the description of the target includes a description of the installation to include degree of protection, personnel, equipment, or activity which is observed. To give the attack helicopter fire team leaders sufficient information for safe mission accomplishment, the observer will give a brief description of the target. This description should be sufficiently informative to enable the FSCoord or S3 to determine the relative importance of the target and the best method of attack. This target data should include—

a. Type of Target, e.g., area or point.

b. Target Defenses.

(1) Active—Antiaircraft ground-to-air weapons, e.g., antiaircraft guns, missiles, tanks, and/or small arms fire.

(2) Number of enemy personnel or units of material comprising the target, e.g., 50 infantry, or 2 tanks, or 1 truck in the open.

c. Location of Friendly Troops.

d. Target Direction. The observer should give a clear description of the target shape when it is significant. When the target shape is rectangular, the length and width in meters is given, and the azimuth of the long axis to the nearest 50 mils is given; e.g., "400 x 200, ATTITUDE 2850." When the target is circular, the observer gives the radius; e.g., "RADIUS 200." All directions (observer, target line, gun-target line (attack heading for aircraft), or azimuth of target's long axis) should be transmitted in both mils and degrees.

6-9. Method of Engagement

a. Type of Adjustment.

(1) Although point type targets can be engaged by attack helicopters, the adjustment procedures used by the observer are no different than for an area target.

(2) The term "danger close" will be included in the method of engagement when friendly elements are 600 meters or less from the target. Actual troop-target separation distances to be considered "danger close" are dependent on numerous elements; and will be included in the unit SOP.

b. Ammunition. If the observer has a preference, he should inform the FSCoord/S3, or fire team leader what type of ammunition (ordnance)

he desires, e.g., "FLECHETTE, HE." Urgency of mission, attack helicopters available, and unit SOP may dictate the armament received.

6-10. Method of Fire and Control

a. Method of Fire. This element may be given to request the number of sections to be used in a firing run. If used, it may be given as, "ONE SECTION (FIRE TEAM) IN ADJUSTMENT, PLATOON IN EFFECT." However, this element is usually omitted by the requester and left to the discretion of the flight leader, based upon his knowledge of the situation and the location of the observer; e.g., airborne or on the ground.

b. Method of Control. This element indicates the control which the observer will exercise over the time of delivery of fire, whether an adjustment is to be made, or whether fire is to be delivered without adjustment. Method of control is announced by the observer by use of the following terms:

(1) *Fire for effect.* When the location of a target is sufficiently accurate to eliminate the requirement for an adjustment, the observer announces, "FIRE FOR EFFECT." Accurate immediate fire for effect has appreciable surprise value and is preferred whenever possible. Fire for effect without an adjustment is warranted when the target has been clearly identified by the flight leader. Unless the observer has requested "AT MY COMMAND," fire for effect indicates that the flight leader may engage the target when ready. Care must be taken to insure that troop safety is not jeopardized by this method. The observer may indicate the amount of ammunition (ordnance) desired in fire for effect. Before the strike is complete the lead aircraft commander should advise the ground commander when one-half of the ammunition is expended. This eliminates excessive time lapse between sections (fire teams) relieving one another on station and permits continuous fire support for the ground commander.

(2) *Cannot observe.* "CANNOT OBSERVE" indicates that the observer is unable to adjust fire. However, he has reason to believe that a target exists at the given location and that it is of sufficient importance to justify firing on without adjustment.

(3) *At my command.* "AT MY COMMAND" indicates that the observer desires to control the time of delivery of fire. The observer announces "AT MY COMMAND" immediately preceding the announcement in (1) above and paragraph 6-11g below. For example, "AT MY COMMAND, FIRE FOR EFFECT," and "AT MY COMMAND, ADJUST FIRE." The observer will then announce

"FIRE." "AT MY COMMAND" remains in effect until the observer announces "CANCEL AT MY COMMAND." "AT MY COMMAND" should be used only when safety of troops is involved. This method of control does not allow the flight leader to engage targets of opportunity.

(4) *Adjust fire.* "ADJUST FIRE" indicates that an adjustment is necessary and that the observer can see and adjust the fire. Unless "AT MY COMMAND" has been included, "ADJUST FIRE" indicates that the flight leader may engage the target when ready.

6-11. Example of Call for Attack Helicopter Fire

a. Observer's Identification. "REDLEG 18, THIS IS REDLEG 24."

b. Warning Order. "FIRE MISSION, ATTACK HELICOPTER."

c. Location of Target. "GRID ND 123456. DIRECTION 1300 MILS (73 degrees)." (Direction is from the observer's location.)

d. Description of Target. "TROOPS IN THE OPEN."

e. Method of Engagement. "FLECHETTE, HE."

f. Method of Fire. "ONE SECTION IN ADJUSTMENT, PLATOON IN EFFECT."

g. Method of Control. "AT MY COMMAND, ADJUST FIRE."

Section II. ATTACK HELICOPTER FIRE ADJUSTMENT AND FLIGHT LEADER COORDINATION PROCEDURES

6-12. General

An observer desiring to engage a target with attack helicopters will initiate a fire request in accordance with FM 100-26 using the format as contained in Section I of this chapter. The field artillery fire direction center (FDC) will convert the observer's call for fire into usable data for the attack helicopter. The fire request will be transmitted to the attack helicopter unit using the following format:

a. Identification. "RED RIDER 18, THIS IS REDLEG 18."

b. Warning Order. "FIRE MISSION."

c. Target Location. "GRID AF 123987."

d. Target Description. "TROOPS IN THE OPEN."

e. Method of Engagement. "FLECHETTES AND WP."

f. Observer Contact. "CONTACT REDLEG 24 ON FL."

attack helicopters are within transmitting range. The initial contact includes the full call sign of mission leader and his estimated time in minutes until arrival in the target area. For example, "REDLEG 18, THIS IS RED RIDER 31. ESTIMATING YOUR LOCATION IN 04, OVER."

b. Situation Report. The observer provides the attack helicopter commander with a situation report. This mandatory report includes as a minimum: the friendly situation, the intensity of contact, and the ground-to-air fire. For example, "All friendly elements are east of the river and in heavy contact with a platoon-size force with automatic weapons."

c. Location of Target. The observer may use any of the target locating methods discussed in paragraph 6-7. Additional information includes—

(1) *Coordinate system.* Although grid coordinates are normally required for navigation to the target area, this is the least desirable method to be used by the observer for pinpointing the target for the flight leader. Since coordinates are difficult to accurately locate in some areas, target identification becomes time consuming and often requires target overflight.

(2) *Polar coordinates.* Polar coordinates consist of the direction and distance from the observer to the target. The observer position must be clearly identified by the flight leader if this mission is used; for example, "DIRECTION 090 DEGREES (see note), DISTANCE 2000," (vertical shift is not used for Attack helicopters). To prevent visual disclosure of the observer's location to the enemy, the most secure means of ob-

6-13. Coordination Elements and Procedures

The helicopter flight leader will contact the observer en route to the target area to effect observer-flight leader coordination. Sequence of information exchange between the observer and the flight leader should include the following:

a. Initial Contact. To permit rapid target engagement by the attack helicopter flight upon arrival in the target area, the flight leader makes the initial contact with the observer as soon as the

server identification must be used, i.e., secure radio transmission, marking panels, highly directional light beams, or other means. Normally, identification methods are prearranged or covered by unit SOP.

Note. Due to aircraft instrumentation, the observer must always use degrees when communicating with aircraft.

(3) *Shift from a known point.* In order to locate a target by a shift from a known point, both the observer and flight leader must know the location of the known point. Prominent terrain features and previously fired targets are commonly used as known points, for example, "FROM STONE HOUSE, DIRECTION 055 DEGREES, ADD 300."

d. *Description of Target.* Description of the target installation includes degree of protection, personnel, equipment, or activity which is observed. This element may be omitted if there has been no change from the initial call for fire.

e. *Friendly Troop Locations.* Where troop safety is a consideration, the helicopter flight leader must positively identify the location of all friendly elements within the target area. The observer must insure that the method used to identify friendly position is (1) visible to the aircraft at the time the identification is accomplished and (2) readily identifiable by the flight leader during his attack of the target. If the location of the target is such that troop safety is not a consideration or it is not desirable to identify the friendly position, the flight leader should be advised, since this is an exception to normal procedure.

f. *Direction of Attack.* Based on the location of friendly elements and other fire support means to be employed against the target, the observer recommends the direction of attack to the nearest 10°, or uses a cardinal direction. The final decision for the direction of attack is decided by the fire team leader. Since troop safety is also the responsibility of the maneuver unit commander, the direction of attack must also be acceptable to him. Where friendly troops are in close proximity to the target, the attack direction normally parallels the front line of the friendly position. This is because aerial weapon system dispersion is considerably greater in range than in deflection.

g. *Reference Line or Point for Adjustment.* If not covered by SOP or if the attack helicopter unit providing the direct aerial fires is not familiar with ground unit SOP, the reference line or point must be agreeable to both the observer and the flight leader. After initial target location, the observer transmits firing corrections to the attack

helicopter in relation to a reference line or point (spotting line). The three reference lines (spotting lines) and one reference point that the observer may select for use in making the adjustments are as follows:

(1) *Gun-target (GT) line.* This method is frequently used when the observer has visual contact with the aircraft and the area where the rounds are impacting. He cannot apply corrections directly, consequently he must extrapolate his corrections to the GT line (attack heading) of the attack helicopter.

(2) *Observer-target (OT) line.* This method requires that the observer mark his location. The observer's corrections to the flight leader are then made along the reference line between the observer and the target. The corrections made by the observer must be applied to the gun-target (attack heading) line by the aircraft commander. This method is useful in initial target identification and in making major adjustments.

(3) *Line of known direction.* The observer may select a line formed by a road, a railroad, a canal, a series of objects, etc. The line must be readily identifiable to both the flight leader and the observer. The observer makes corrections in relation to the reference line and these corrections are applied to the gun-target line by the aircraft commander.

(4) *Impact point.* This method requires the observer to make corrections from the impact of last rounds using compass directions, for example, "NORTHWEST 100" (meters). In some situations, attack helicopter commanders may experience difficulty in locating the point of impact of last rounds on subsequent firing passes. This method of adjustment is most adaptable for use by aerial observers.

h. *Ammunition/Fuel Status.* The helicopter flight leader should inform the observer of the amount and type of ammunition (ordnance) carried by the attack helicopters. Also periodically throughout the conduct of the mission, he should inform the observer of the ammunition and fuel status of the flight. This enables the observer to determine if additional direct aerial fires are required to neutralize the target. If needed, a fire request can be initiated to permit aircraft relief on station. Normally, this permits immediate fire for effect by the relieving attack helicopter and negates the requirement for time consuming adjustments.

6-14. Subsequent Corrections

The procedures for subsequent corrections are as follows:

a. Correction for Deviation. The observer transmits deviation corrections to the nearest 10 meters as "RIGHT (LEFT) (so much)."

b. Correction for Range. If there are no range corrections, the range element is omitted; for example, "RIGHT 200, OVER."

(1) *Add.* The term "ADD" is used by the observer to move subsequent burst(s) away from the observer along or parallel to the OT line. If the burst(s) falls short of the target, the observer commands "ADD (so much)."

(2) *Drop.* The term "DROP" is used by the observer to move subsequent burst(s) toward the observer along or parallel to the OT line. If the burst(s) appears beyond the target, the observer commands "DROP (so much)."

c. Correction for Height of Burst. The observer transmits height-of-burst corrections to the nearest 5 meters as "UP (DOWN) (so much)." This correction is not used for adjustment of attack helicopter fire.

d. Change in Control. When the observer desires to change the method of control (other than "AT MY COMMAND"), he announces the new method of control; for example, "FIRE FOR EFFECT."

e. Repeating Previous Fire Data.

(1) The term "REPEAT" is used to indicate that the observer desires a subsequent round or group of rounds fired with no corrections to deviation, range, or height of burst. For example, if several rounds burst in the area of observation simultaneously and the observer could not determine which rounds to observe, he would request "REPEAT" or "WP REPEAT."

(2) The term "REPEAT" is also used to indicate that the observer wants fire for effect repeated with or without changes or corrections to any of the elements; for example, "ADD 50, REPEAT."

f. Correction of Errors. If the observer discovers an error or omission in the transmission or read-back of a subsequent correction, he corrects the error as appropriate (para 9-10, FM 6-40).

g. Additional Information. If the observer desires to transmit information necessary to the conduct of a mission and there is no specific format prescribed, he should transmit the information in clear, concise language in a sequence least likely to cause confusion and most likely to expedite the mission.

6-15. Termination of Attack

Attack of the target is continued until—

- a.* the target is destroyed,
- b.* the attack is terminated by the observer,
- c.* the attack is terminated by the appropriate commander,
- d.* all ammunition is expended, or
- e.* Allowable fuel is expended. On completion of the mission, the flight leader passes in-flight damage assessment and intelligence.

6-16. Target Definition

a. Point Target. A point target may be attacked with all available firepower on the initial attack if this is decided upon by the fire team leader. If friendly units are in the general area, positive identification of friendly positions must be made.

b. Area Target Near Friendly Troops. Once all friendly positions have been positively identified, the recommended procedure is to fire only one pair of rockets or short bursts of automatic weapon fire into the target area. When the tactical situation permits, continuous smoke should be used by ground elements to mark their position. To continue fire on target, an individual on the ground, an aerial observer, or a helicopter crewmember must observe the initial bursts and make appropriate adjustments.

CHAPTER 7

GUIDELINES FOR ATTACK HELICOPTER EMPLOYMENT

7-1. General

Factors affecting the employment of attack helicopters are METT (mission, enemy, terrain and weather, and troops and equipment) and the guidelines for employment. For a discussion of METT, see FM 1-100. It is not always possible to follow the established rules precisely; however, as with the factors of METT, these rules must be weighed and then violated only when necessary to accomplish the mission. The 12 guidelines (para 7-2 through 7-13 below) are combat-proven guides for low-intensity operations which enhance mission success and increase survivability in the combat environment.

7-2. Know the Situation

It is imperative that attack helicopter crews know the ground tactical situation if they are to provide the accurate, timely fire support required. Crewmembers must obtain all the information possible from operations plans and orders, use complete prior planning, and constantly review intelligence reports.

7-3. Brief and Debrief

To perform his duties properly, every member of the team must know the situation, the mission, and the plan of execution. Use of the five-paragraph operation order format will insure clarity and completeness in the briefing. Debriefing the team on completion of the mission will often bring out valuable intelligence information, and the crew will benefit from lessons learned.

7-4. Avoid Flight in the "Deadman" Zone

When possible, flight in the "deadman" zone should be avoided. The "deadman" zone is that airspace where most aircraft hits occur. This zone is dictated by the terrain and the enemy's effective firepower. It will vary from area to area, under different intensities of conflict, and when facing different enemies. This zone is also that airspace which provides the best air-to-ground observation. For this reason, it is not always possible to meet the requirements for reconnaissance

and stay out of the zone. When required to operate in or pass through the "deadman" zone, the flight should be completed as quickly as possible.

Note. Experience factors gained in combat in Vietnam indicate that for that type conflict and under those terrain conditions, the "deadman" zone is from 50 to 1,000 feet above the terrain, with the airspace from 50 to 500 feet being the most hazardous. Tests in a high radar environment type of conflict indicate that the best altitude for tactical effectiveness and survivability is near nap-of-the-earth to approximately 260 feet above ground level. Day or night, this altitude is relative to the maximum range of the threat weapons and the terrain.

7-5. Avoid Flying the 180° Tail Position

a. When both the fire team leader and the wingman fly the same ground track, the following conditions result:

(1) Observation as a team is reduced. Both helicopter crews are observing the same terrain.

(2) Enemy gunners can place enfilade fire on the entire team without changing their position.

(3) The hostile force is alerted by the first helicopter, and will either take cover or place fire on the second.

b. To employ his fire team, the leader should establish the axis of advance over the most favorable terrain for the entire team. The wingman is allowed to fly "free cruise" to provide the leader with both fire and observation support.

c. "Free cruise" varies 45° to either side of the axis of advance. Range and altitude separation between the helicopters will depend upon the altitude at which the team is operating. At low level (nap-of-the-earth) the wingman will normally fly slightly higher than the leader so that he can keep him in sight and be able to devote more attention to covering and staying in position, with minimum attention to obstacle clearance. The range separation will be that which provides effective fire support for low-level flight, usually 300 to 400 meters or greater as helicopter speed increases.

d. At higher altitudes, the wingman will normally fly slightly lower than the leader so that he can readily detect changes in the altitude of the lead helicopter. Also, the range separation should

be increased so that the wingman can place effective fire under the lead helicopter and avoid too steep angles of attack.

7-6. Avoid Flying Parallel to Terrain Features

Terrain features, such as tree lines, provide good concealment for enemy forces who will normally orient their fields of fire toward the open areas. Flight parallel to these features could lead the fire team through the gauntlet of enemy fire. Continually flying parallel to terrain features establishes a pattern. The enemy will recognize and take advantage of this pattern to set up an ambush. Flight over linear terrain features should be conducted at maximum speed and at varying angles—the more nearly perpendicular, the better.

7-7. Always Assume the Area Is Hostile

The assumption that an area is safe just because no hostile fire has been received from it, especially in guerrilla-type conflicts, can be fatal. Also, a reconnaissance by fire with negative results is not a guarantee that the area is safe. Well-trained enemy troops will not respond to reconnaissance by fire. The best approach is to assume that the area is hostile until proven safe, then to continually evaluate tactics and techniques and avoid establishing set patterns of employment.

7-8. Make a High Reconnaissance First

A high reconnaissance may not always be possible. Circumstances that can prevent a high reconnaissance include weather conditions such as low cloud ceilings, the tactical situation such as the known presence of antiaircraft weapons, or situations when mission security would be jeopardized. If the situation permits, a high reconnaissance offers the following advantages:

It:

- a. Determines the objectives to be examined more closely during low reconnaissance.
- b. Determines terrain over which to descend and ascend through the "deadman" zone.
- c. Determines routes for contour flying into and away from critical areas.
- d. Permits preliminary terrain analysis, especially with respect to enemy observation capability and fields of fire.
- e. Reduces vulnerability to small arms fire to a minimum.

7-9. Locate the Friendly Troops

During fast-moving situations or when attack hel-

icopters are called upon to furnish fire support with no prior knowledge of the ground tactical plan, it is of primary importance that friendly positions are positively located. Attack helicopter crews should not return hostile fire until the friendly positions are known. When possible, constant visual and radio contact should be maintained with friendly troops.

7-10. Avoid Target Overflight

Even when providing a large volume of fire, attack helicopters are more prone to sustain hits during target attacks near the target than on any other mission. Two steps to avoid overflying the target are to—

- a. Engage target at maximum effective range. The maximum effective range is the greatest distance at which a weapon may be expected to fire accurately to inflict casualties or damage.
- b. Disengage target before reaching enemy's effective antiaircraft range. Depending upon the requirements of the mission, it is desirable to disengage a target before reaching the enemy's effective small arms antiaircraft range. Normally, current estimates of enemy capabilities, types of weapons, effective range, etc., will be provided through G2/S2 channels.

7-11. Avoid Firing Over the Heads of Friendly Troops

When enemy forces are engaged, the enemy positions normally parallel the friendly positions. Thus, attacking from over the friendly troops makes poor use of enfilade fire. Since enemy weapons are oriented toward the friendly force being supported, attack helicopters increase their exposure by attacking directly into the fields of fire. Also when attacking over friendly troop positions, falling rocket caps and machinegun brass can cause confusion and injuries among these troops.

7-12. Conserve Ammunition

Attack helicopter commanders must remember their mission and conserve their ammunition, using it wisely for that mission; they should avoid expending ammunition for other than support of the primary mission. Also, ammunition should be conserved for contingencies such as rescuing downed aviators and other unplanned tasks. One method of conserving ammunition is to regularly reserve a certain percentage of the ammunition load for contingencies. This technique should be specified in the unit SOP.

7-13. Take Your Time

To insure the application of sound tactics and accurate delivery of aerial fire, a plan of execution must be formulated for any aerial attack. Plans of execution are developed more rapidly as the crew

gains experience. To prevent haste in plan execution, inexperienced crews must take time to consider the first 11 guidelines (para 7-2 through 7-12). Tactical results are better when (if necessary) extra time is taken to do the job right.



CHAPTER 8

TARGET ACQUISITION

Section I. AERIAL ACQUISITION

8-1. General

Using visual means or airborne surveillance equipment, targets may be acquired by an attack helicopter crew or by an observer in another aircraft. An infantryman or a trained ground observer may also acquire targets (sec II). For calls for attack helicopter fire, see chapter 6.

8-2. Target Acquisition

Normally, day target acquisition is by visual detection. It may also be by radar or specialized equipment. Night target acquisition may be by radar, specialized equipment, or visually with the aid of artificial illumination (para 3-21).

a. Reconnaissance. Target acquisition always involves some type of reconnaissance. Reconnaissance is a continuous effort by the entire crew of an attack helicopter. A specific mission may or may not be stated as a reconnaissance task, but reconnaissance is a part of every mission. A thorough reconnaissance is necessary for either a known target location or for targets of opportunity.

(1) *Known target.*

(a) The known target is detected by some type of aerial surveillance or method of ground surveillance. The mission is given to the attack helicopter team. Their task is to pinpoint the target specifically before attacking it. To accomplish their task, the factors of METT and the guidelines for employment (chap 7) must be considered. Based on this analysis of the target, the fire team then performs a reconnaissance of the target area by flying at the best altitude for observation, depending upon the terrain, vegetation, and enemy situation. The fire team leader must find a position from which to best determine exactly what the target is, what it looks like, and where it is located. Once this has been determined, the leader can form his plan of attack and issue his fire command.

(b) Before sending the fire team to attack a known target, aerial photography can be helpful in locating it. Aerial photography often gives the

first indication that a target is in the area. If possible, a visual reconnaissance should be made before attacking a target identified by a photograph.

(2) *Targets of opportunity.* Targets located by reconnaissance by the attack helicopters are targets of opportunity. Surprise targets which the attack helicopter reconnaissance happens to locate are also targets of opportunity. Care must be taken to insure that targets of opportunity have been confirmed as the enemy.

(a) Targets may be spotted visually by the crew. Targets spotted by the crew may be picked up by movement, fresh digging, trails, smoke from campfires, poorly camouflaged positions, fortifications, vehicle traps and many other clues which can arouse suspicion in the search area.

(b) Reconnaissance by fire is another method of locating targets. This leads a poorly disciplined enemy to move or to return fire and thus give away his position.

(c) Targets may be located by drawing enemy fire. They may disclose their positions as a result of enemy fire directed toward the attack helicopter team. This is frequently the case when escorting troop-lift helicopters en route.

(d) Often the enemy fire will pinpoint the target; but if tracers, smoke, muzzle flash, or other motion is not detected, some sort of search of the general area must be conducted to locate it. Conduct of this search must be determined by and based on the factors of METT. Normally, the commander of the fire team must request permission from the ground commander or higher headquarters to engage the target. There may be situations where he will already be cleared when he is sent into the area of known targets, but he may have to verify friendly element locations before determining how to engage the target.

b. Night Acquisition. At night or during periods of low visibility, target acquisition becomes more difficult and crew responsibilities take on added importance. Proper crew training and knowledge of techniques available (app D) can turn the op-

eration into an advantage for the fire team. Aids to night target acquisition include—

(1) *Artificial illumination.* Night target illumination may be accomplished by aircraft flares, artillery illuminating rounds, and ground or helicopter-mounted searchlights (para 3-21b). Some searchlights provide both white light and infrared illumination, each of which may be used. When using artillery illumination, radio contact must be maintained between the fire team leader and the artillery unit firing the rounds. When using these artificial means of illumination, care must be taken to avoid being blinded and/or entangled with parachutes of flares that have burned out but are still aloft.

(2) *Infrared devices and starlight scopes.* Infrared devices and starlight scopes may be used effectively to locate targets at night; but even then, it is often difficult to identify the target location for other helicopters in the attack helicopter team. One effective method is to use the infrared device with an automatic rifle loaded with full tracer ammunition to mark the target. Another method of identifying the target is by illuminating it with an aircraft flare (para 3-21a), after locating it with the surveillance device. Still another method is to have the searchlight operator use the starlight scope to locate the target, then illuminate it with the searchlight.

(3) *Radar.* Ground radar units and observation aircraft using airborne surveillance equipment can vector the fire team to the target.

(4) *Aerial photographs.* Aerial photographs

will help pilots find targets at night. The photographs will show terrain features such as canal lines, tree lines, and ridge lines which may be visible at night, making it easier to navigate to a known target.

(5) *Enemy fire.* By spotting muzzle flashes or tracers (para 9-1a), enemy fire may often be spotted from the air. However, the observer must rapidly pinpoint the muzzle flash or tracer location before it disappears and is lost.

c. *Spot Reports.* In many situations, the fire team commander must request permission in accordance with existing directives to attack a specific target. The spot report can be used to make the request. This report enables the ground commander or higher headquarters to keep abreast of the situation, determine the importance of the target in relation to the mission, and advise the fire team of situational changes in the target area, such as friendly movements. Reconnaissance reports should be transmitted using tactical speech security equipment, when available (FM 32-5). This type of report must include the following information—

(1) *Observer identification.* Identify yourself.

(2) *Description of target.* Identify target.

(3) *Location of target.* Give target coordinates.

(4) *Activity.* What is the target doing (e.g., moving convey, troops moving, etc.)?

(5) *Requested action.* What action you desire to take against the target.

Section II. TARGETS ACQUIRED BY GROUND OBSERVERS

8-3. General

Ground elements acquire many targets for attack helicopters. Transmitting target information from the ground element to the attack helicopters causes special problems. These problems are compounded during night operations or periods of low visibility. A simplified fire request system must be used by the ground observer to minimize the difficulties of calling for attack helicopter support. Usually this is accomplished by FM radio as a result of an exchange of SOI between the ground element and the fire team.

8-4. Employment Considerations

a. To effectively employ the available direct aerial fires, the supported force commander must consider—

(1) *Nearness to friendly forces.* Several fac-

tors that determine how near aerial fires may be delivered to friendly forces are the enemy situation, nature of threat, type of aerial fires, type of ammunition used, and disposition of friendly forces. Also, effective employment of the available close air support often depends on the battlefield situation. The following employment distances are for planning purposes only. They should be used with discretion and adjusted as appropriate. Normally—

(a) Daytime machinegun and cannon fire may be brought to within 50 meters of friendly forces (25 meters in an emergency).

(b) Daytime rocket and grenade fire may be employed to within 75 meters (50 meters in an emergency). Depending on type of fuze and warhead (app C) employment distance for rockets may be greater.

(c) Night employment distances are generally greater than daytime distances due to the hazards of night flight close to the ground. However, accuracy and effectiveness of night fire support will depend on crew experience.

(2) *Response time.* The time required for the attack helicopter to reach the target area depends for the most part upon the proximity of the helicopter staging area to the target area. As a general rule, normal time for attack helicopter response has been found to be 15 to 20 minutes from receipt of mission until arrival on station.

(3) *Adverse weather.* The experience of the attack helicopter commander and the capability of the attack helicopter will determine ceiling and visibility required for the mission. Ceiling and visibility requirements will increase in unfavorable terrain, e.g., mountains.

b. Prior to the execution of a particular mission, the supported force commander (or his designated representative) must determine the requirements for attack helicopter support. This support will be integrated into the overall plan of action.

8-5. Night Operations

Night operations make it especially difficult for a ground observer to convey what he sees to the attack helicopter team. Several methods may be used to assist fire direction and target identification from the ground at night.

a. *Illumination.* Use of illumination is similar to that used for artificial night target illumination para 8-2b(1)).

b. *Radar.* Ground radar units can vector the attack helicopter to the target (para 8-2b(3)).

c. *Marking.* Marking a target or friendly position at night by the ground observer is especially critical and requires close coordination. Flare pots or some other light system may be used instead of smoke; e.g., lights arranged in the shape of an arrow pointing in the direction of the target. Artillery or mortar fire may also be used to mark a target. Additional means of marking include strobe lights, railroad flares, trip flares, and tracers.



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CHAPTER 9

HOSTILE FIRE COUNTERMEASURES

9-1. Detection of Hostile Fire

Hit data compiled by Ballistic Research Laboratories reveals that the majority of aircraft hits occur during target attacks. The ability of an attack helicopter crew to successfully counter hostile fire depends upon the crew's state of training, alertness, aggressiveness, and ability to detect the hostile fire. At present, hostile fires can be detected visually or by sound. As the state-of-the-art progresses, acoustic or other electronic devices will be developed for use on attack helicopters to aid in the detection of hostile fire.

a. Visual Detection. Most hostile fire can be observed visually by detecting the characteristic orange color of muzzle flash or tracers. Much of the tracer ammunition used by Soviet-bloc nations has a slightly greenish tint that is easily distinguished from the orange-red tint of tracer ammunition used by Western nations.

b. Auditory Detection. Hostile fire may be detected by the sonic snap that bullets make when passing nearby. This sound is distinguishable from the sound of the rotor blades by both tone and duration.

9-2. Types of Countermeasures

Each crew must constantly train for the possible actions it will take if hostile fire is received. The tactical situation will determine whether these actions should be passive or active.

a. Passive. The unit SOP will contain the spot report format for reporting hostile fire. Passive countermeasure actions include—

(1) *Evasive action.* Evasive aircraft maneuvers are employed to avoid being hit by hostile fire.

(2) *Smoke.* Smoke may be dropped to mark the general location of the hostile fire. Unit SOP will establish the color coding for the use of smoke grenades.

b. Active. Active countermeasure actions will normally include those passive actions in *a* above with the addition of countermeasure fire by—

(1) *Helicopter weapons.* Integral weapons may be used to neutralize hostile fire long enough for the helicopter to break contact. Direct hits are not necessarily a requirement in neutralizing hostile fire; often the sound of the weapon being fired is sufficient to momentarily silence hostile fire.

(2) *Friendly ground fire.* Fire by friendly ground elements can be effectively used to neutralize hostile ground-to-air fires directed at helicopters. Prior planning for this fire is essential to prevent friendly positions being mistaken for the hostile positions.

(3) *Artillery, tactical air, and naval gunfire.* Heavier fire support may be required to neutralize hostile antiaircraft fires. Complete, prior planning for these fires is normally required.

9-3. Techniques in Countermeasure Action

The particular technique or maneuver required will depend upon the type of hostile fire encountered.

a. Small Arms. Hostile small arms fire, including caliber .50 (12.7mm), is normally countered by high volume, short duration neutralization fire, accompanied by an immediate turn in direction as announced by the aircraft commander, away from the hostile fire and toward an area providing screening or concealment. If concealment is not readily available, sharp turns of unequal magnitude and at unequal time intervals will provide the best protection. These turns are continued until the helicopter is beyond the effective range of the hostile weapon. Immediately upon receipt of hostile small arms fire, a well-trained crew will—

(1) Mark the position with smoke.

(2) Report, "Receiving fire from _____ o'clock position, range _____ meters."

(3) Determine if countermeasure fire is required.

b. Large Caliber Antiaircraft Fire. When large caliber antiaircraft fire is encountered (e.g., 37mm and 57mm), especially if fires are suspected to be radar controlled, an immediate 90° turn

should be executed. If the first burst of flak does not hit the intended helicopter, this 90° turn will move the helicopter away from the burst and the radar will continue to track the burst. After turning, a straight line of flight should never be maintained more than 10 seconds before a second 90° turn is initiated. Through all turns and straight lines of flight, an immediate descent will further reduce the danger by getting the helicopter out of the killing zone of the large caliber weapon.

c. High Performance Aircraft. While in an area of known or suspected enemy high performance aircraft, the pilot should fly the helicopter nap-of-the-earth as much as possible. Upon sighting hostile high performance aircraft, he should continue on the established flightpath until the hostile aircraft starts its attack dive. Once the attack dive is initiated, he turns immediately toward the attacker. This maneuver will cause the attack angle of the hostile aircraft to increase. The hostile aircraft must cease his attack or he will be unable to recover from the maneuver. Once the attack is broken, the helicopter should be maneuvered to take advantage of terrain and vegetation for concealment and cover to avoid being attacked again.

d. Night Operations. Evasive actions for hostile fire received at night consist of

(1) An immediate turn away from the hostile fire.

(2) Turning out the anticollision light or those lights visible to the hostile gunner. When these lights are turned out, the navigation lights should be sufficient to provide aircraft identification and show position within the flight. The navigation lights give the other helicopters in the fire team the capability of providing effective neutralization fire. After the threat has been eliminated, lights are switched to normal.

Note. All aircraft should have the bottom half of navigation lights taped or painted to allow for in-flight aircraft identification and eliminate aircraft detection from the ground. Navigation lights should be placed on STEADY/DIM position.

(3) Evasive action for heat seeking missile. To evade a heat seeking missile, the best maneuver is for the pilot to mask the helicopter either behind or in front of terrain features. By far the most effective countermeasure for this type of anti-aircraft threat is for the pilot to make all approaches and attacks from the direction of the sun. If flying at altitude, he should remain as close as possible to the base of cumulus clouds. Based upon the practical situation, he should always fly nap-of-the-earth when possible.

PART THREE ARMAMENT SUBSYSTEMS

CHAPTER 10 OH-6A/OH-58A HELICOPTER ARMAMENT SUBSYSTEM M27E1

Section I. DESCRIPTION AND DATA

10-1. Description

The high rate 7.62mm machinegun helicopter armament subsystem M27E1 is used on the OH-6A/OH-58A helicopter. The gun is located on the left side of the aircraft, attached to the external portion of the mount assembly (fig 10-1 and 10-2).

a. Gun Assembly. The main components of the gun assembly (fig 10-3) are the 7.62mm machinegun M134, delinking feeder MAU-56/A, gun electric drive assembly, sensing unit and the cable assembly, ejection chutes, and two gun mounting adapters.

(1) *7.62mm machinegun M134.* The components of the 7.62mm machinegun M134 (fig 10-4) are the rotor assembly, six bolt assemblies, six removable bolt tracks, gun housing assembly, rear gun support, six barrels, barrel clamp assembly, safing sector, housing cover, and two quick-release pins. As the rotor turns within the stationary housing cover, the bolt assembly rollers follow the main cam path of the housing cover, causing the bolt assemblies to move along the accommodating tracks. Each barrel is mounted in the barrel clamp assembly, in a fixed position, in alignment with a bolt assembly.

(a) Rotor assembly and removable bolt tracks. The rotor assembly (fig 10-5) is supported in the gun housing by ball bearings. Six bolt tracks are spaced equally around the rotor surface. Each bolt track is composed of front and center portions, which are grooves cut into the rotor, and a removable bolt track (fig 10-6). The removable bolt tracks are attached to ribs along the rotor and are removed for installation or removal of bolt assemblies. An S-shape triggering cam, machined into the bottom of each bolt track, cocks and releases bolt firing pins.

(b) Bolt assemblies. The bolt assemblies (fig 10-7) are of rotary-head and fixed extractor

design, with side slots engaging the bolt tracks in the rotor assembly. The angular position of the firing pin relative to the bolt head is controlled by the action between the firing pin tang and the triggering cam in the rotor. The firing pin extends through the bolt body into the bolt head and connects the two parts during ramming and extraction. Extractor lips, machined in the bolt head, extract spent cartridge cases.

(c) Gun housing assembly. The gun housing assembly (fig 10-8) is a one-piece casting which covers the rotor assembly and provides a mount for the safing sector, housing cover, and guide bar. The inner surface of the gun housing assembly carries the elliptical main cam of the gun which controls bolt assembly motion.

(d) Safing sector. The safing sector (fig 10-9) is attached to the gun housing assembly by two quick-release pins and acts as a safing device for the gun. The inner surface of the safing sector contains the segment of the cam path which brings bolt assemblies into battery position and allows firing pins to be cocked. When the safing sector is removed, bolt assemblies cannot be cammed into battery by manual or mechanical rotation of the barrels, nor can firing pins be cocked and released by the triggering cam in the rotor assembly.

(e) Housing cover. The housing cover (fig 10-10) is secured to the gun housing assembly and safing sector by two quick-release pins and provides an inspection and service access to the bolt assemblies in position along the upper surface of the rotor assembly.

(f) Guide bar. The guide bar (fig 10-11) is held to the gun housing assembly by a permanently installed pin at the front end and a screw at the rear. The guide bar fingers direct cartridge cases out of the extractors into the ejection chute.

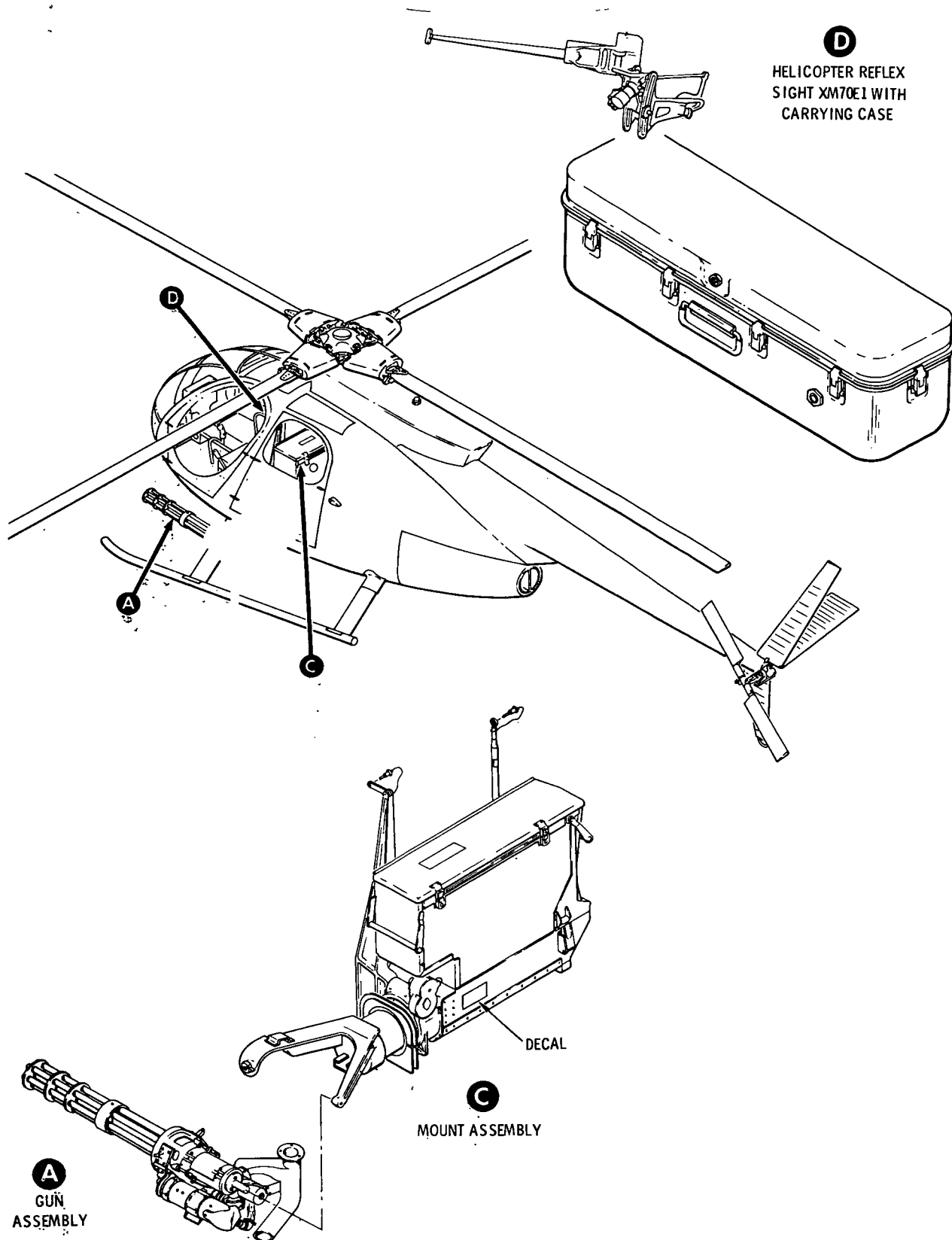


Figure 10-1. Components of M27E1 armament subsystem on OH-6A.

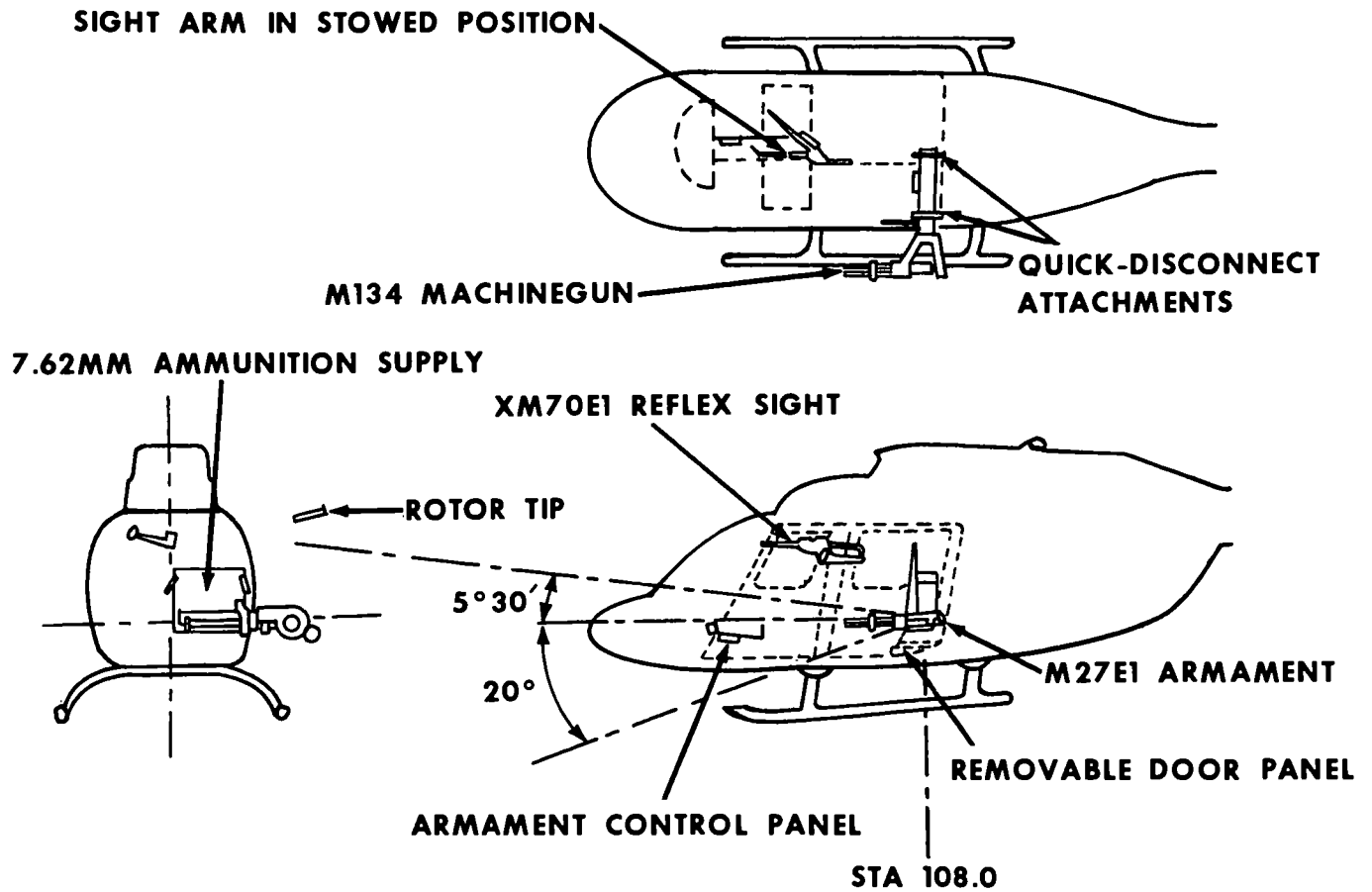


Figure 10-2. Components of M27E1 armament subsystem on OH-58A.

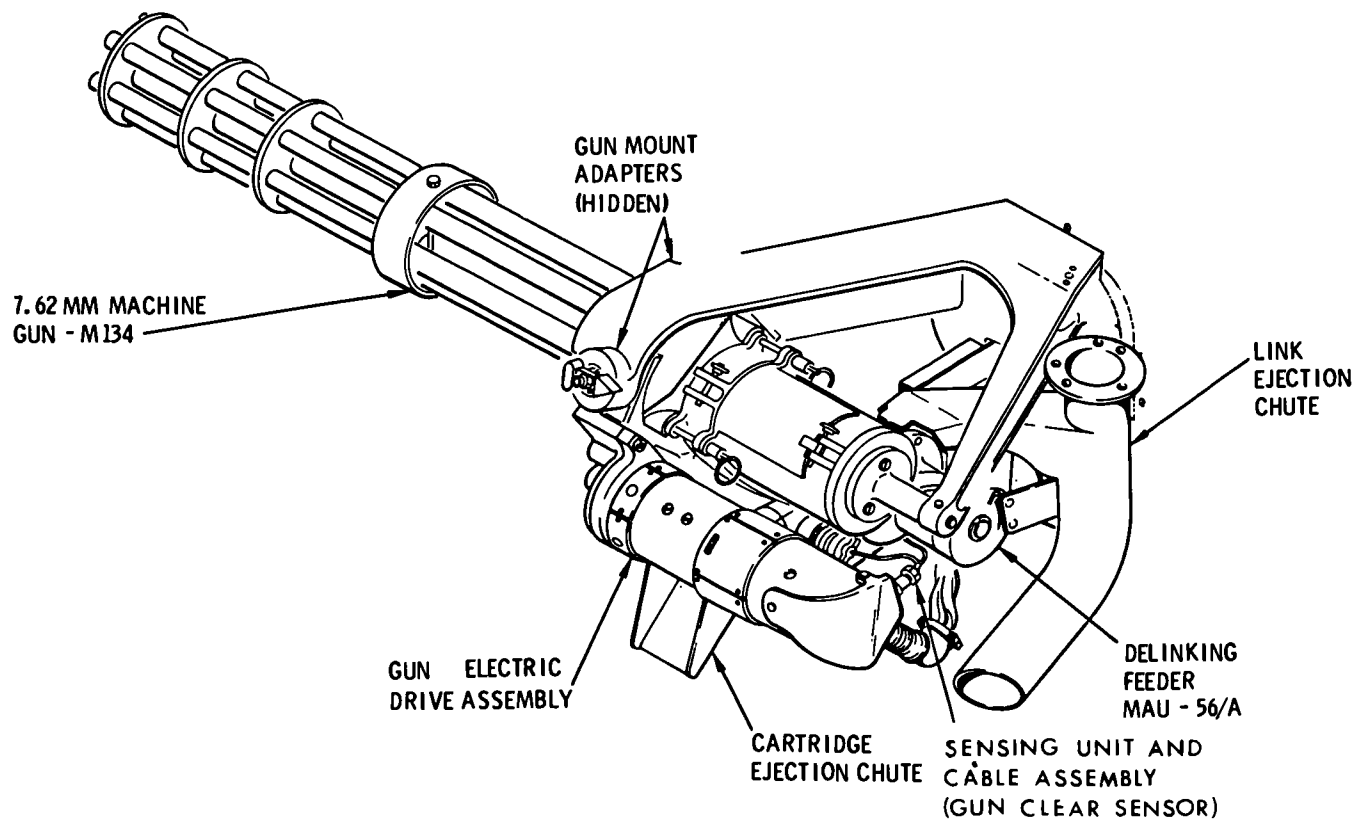


Figure 10-3. Components of gun assembly.

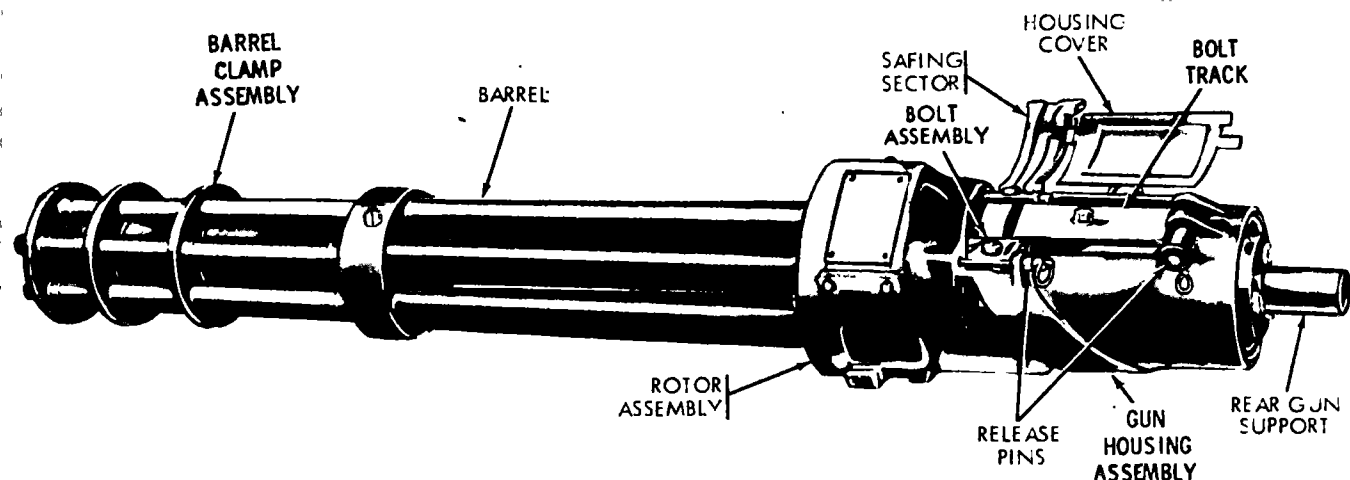


Figure 10-4. Components of 7.62mm machinegun M134.

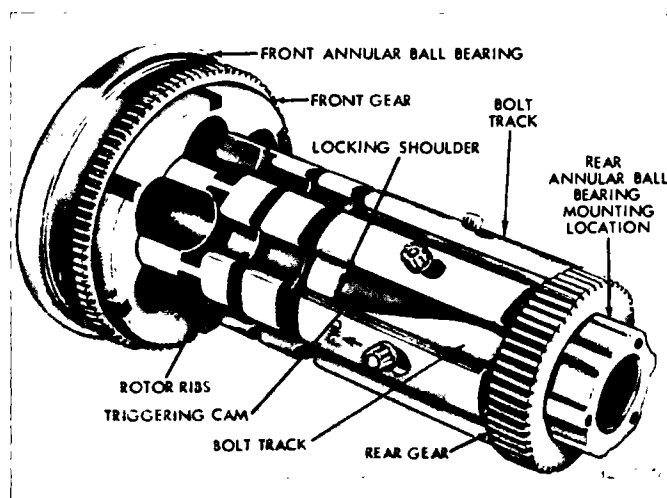


Figure 10-5. Rotor assembly.

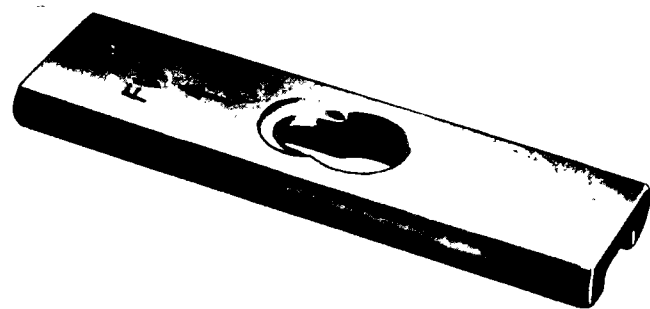


Figure 10-6. Bolt track.

(g) *Rear gun support.* The rear gun support (fig 10-12), secured to the rear of the rotor assembly, retains the rotor assembly in the gun housing and serves as the rear support point for the gun.

(h) *Barrel and barrel clamp assembly* (fig

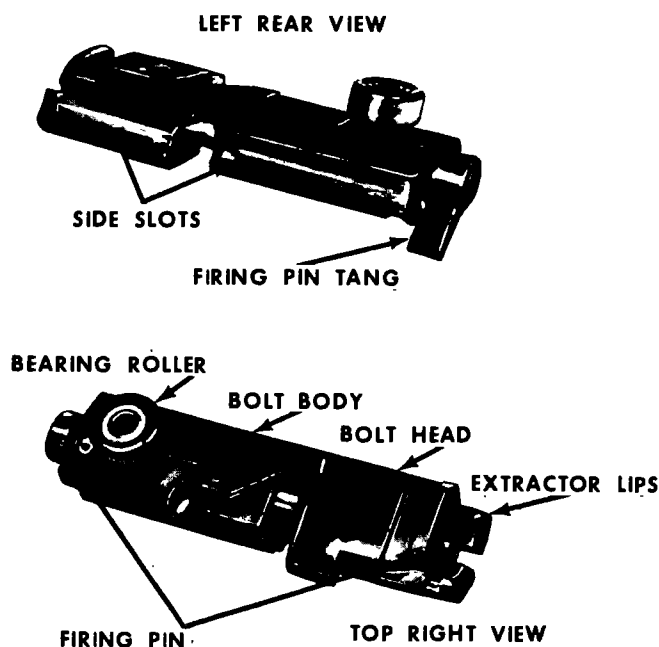


Figure 10-7. Bolt assembly—left rear and top right views.

10-13). Barrels are chambered for the 7.62mm NATO cartridge. A flange, located near the breech end of the barrel, locks in a rotor groove when the barrel is inserted in the rotor assembly and given a half-turn. Steps along the barrel and at the muzzle provide mounting for the barrel clamp assembly which is locked in place on the barrel cluster by a bolt and self-locking nut.

(2) *Delinking feeder* (fig 10-3). The delinking feeder conveys the ammunition from the ammunition chute, strips and ejects the links, and feeds the cartridges into the gun.

(3) *Gun electric drive assembly* (fig 10-3). The gun electric drive consists of an electric

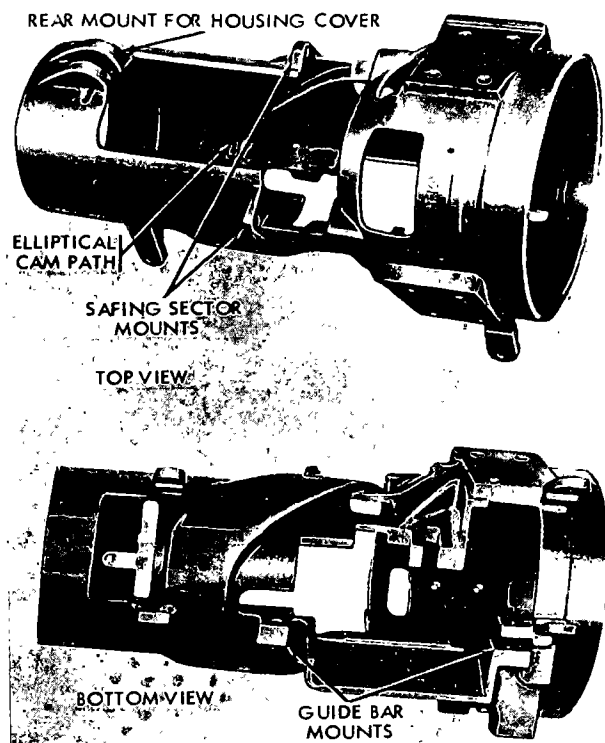


Figure 10-8. Gun housing assembly.

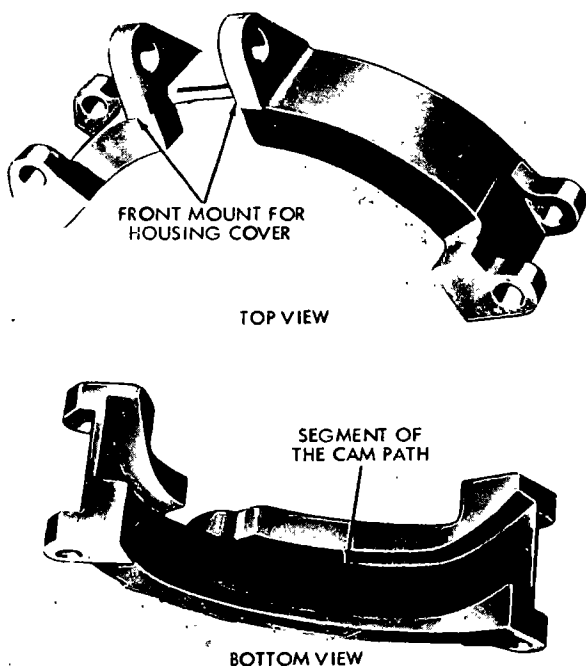


Figure 10-9. Safing sector.

motor with a gear housing and a gun drive control assembly. The motor is a dual commutator type and has both series and parallel windings. Motor connections are electronically switched by the con-

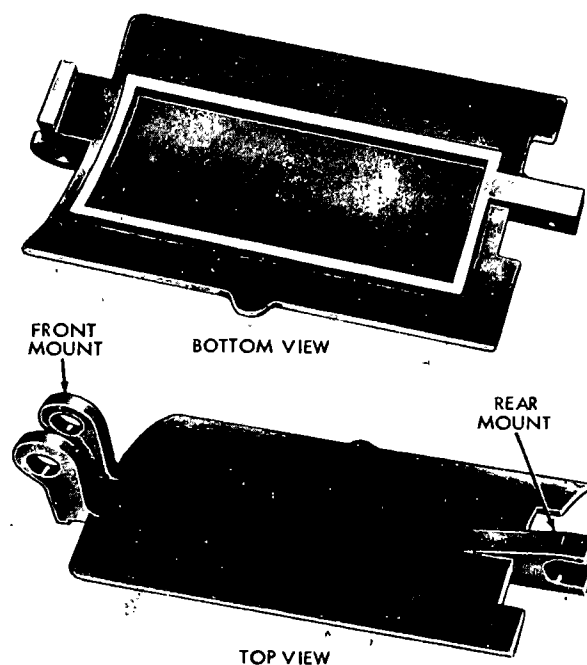


Figure 10-10. Housing cover.

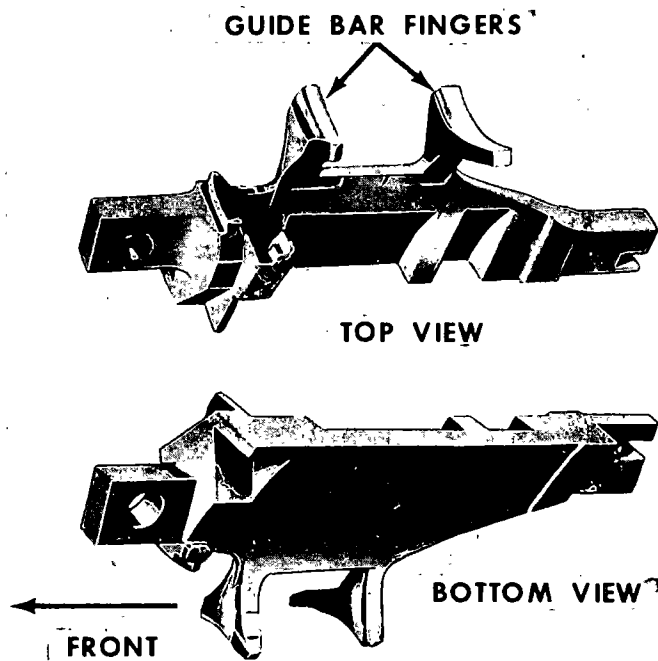


Figure 10-11. Guide bar.

trol assembly to permit rates of fire of 2,000 rounds per minute (series connection) or 4,000 rounds per minute (parallel connection).

(4) *Sensing unit and cable assembly* (fig 10-3). The sensing unit and cable assembly (gun clear sensor) is a magnetic pickup that is mounted on a special nose guide plate on the gun. This unit permits counting live rounds ejected

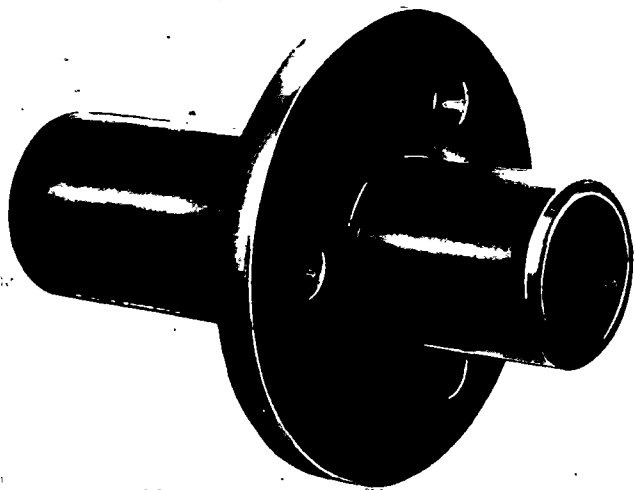


Figure 10-12. Rear gun support.

during a fire-to-clear operation by transmitting a 1.4-volt pulse as each round is cleared. The cable is permanently attached to the sensing unit and incorporates two connector plugs.

(5) *Ejection chutes (fig 10-3)*. Two ejection chutes are attached to the delinking feeder to direct ejected links and empty or live cartridges from the gun to the exterior of the fairing.

(6) *Gun mounting adapter (fig 10-3)*. Two adapter fittings are provided to permit quick attachment of the machinegun to the gun mount assembly. One adapter fits into a neoprene lined shock isolator in the mount assembly. The other adapter mates with a single half-turn gun mount lock to secure the weapon in the mount assembly.

b. *Fairing Assembly (fig 10-1)*. The gun fairing assembly is an aerodynamic shaped fiberglass cover which incloses the aft portion of the gun assembly. It consists of upper and lower assemblies. The upper assembly is secured to the mount assembly by means of three wing-type (turnlock) fasteners. The lower assembly is attached to the upper assembly by seven wing-type (turnlock) fasteners. A ram air duct, bonded to the upper fairing assembly, directs high velocity air into the link ejection chute, insuring that ejected links are clear of the aircraft.

Warning: The fairing assembly must be installed for all weapon firing missions, since in-flight firing without ram air duct may result in damage to aircraft tail rotor.

c. *Mount Assembly (fig 10-14)*. The mount assembly consists of the following main components:

(1) *Door filler assembly*. A door filler assembly is provided to fair in the opening between the mount assembly torque tube and the aircraft door. The door filler assembly is constructed of flexible plastic and is split on one side so that it can be sprung over the torque tube. The door filler assembly is attached to the aircraft door with five screws. The screws removed from the aircraft armament door are reused in this installation.

(2) *Ammunition container assembly*. The ammunition container is a spotwelded and riveted aluminum assembly with a capacity of 2,000 rounds of ammunition. The assembly includes

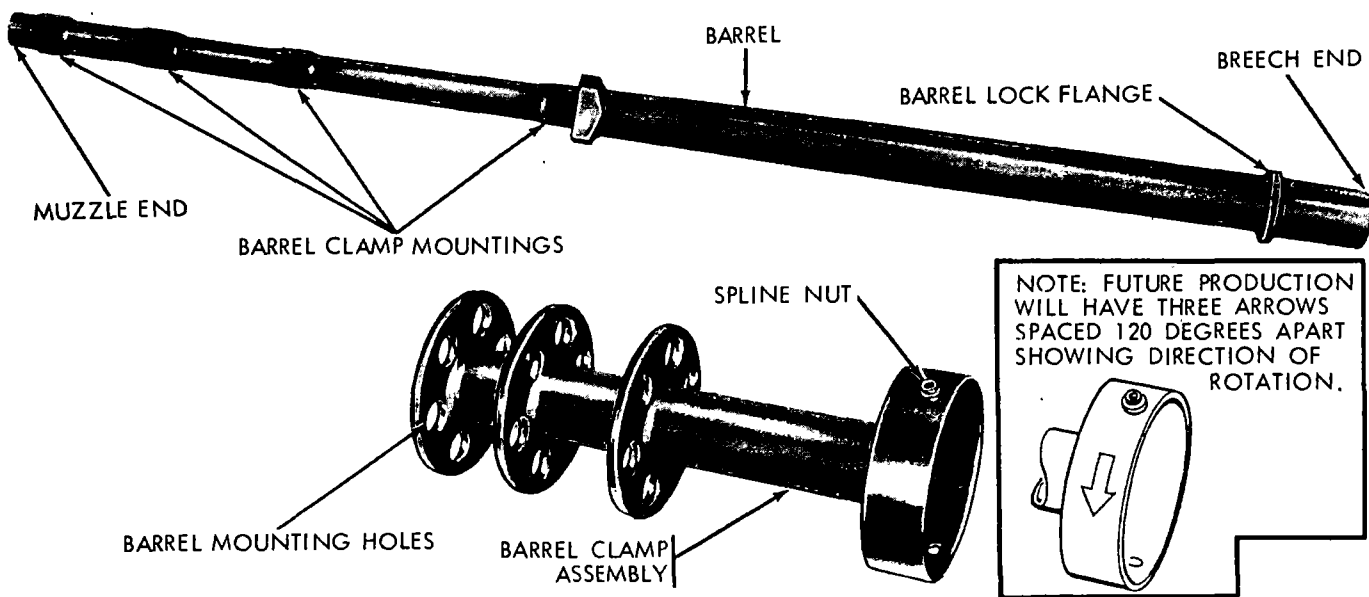


Figure 10-13. Barrel and barrel clamp assembly.

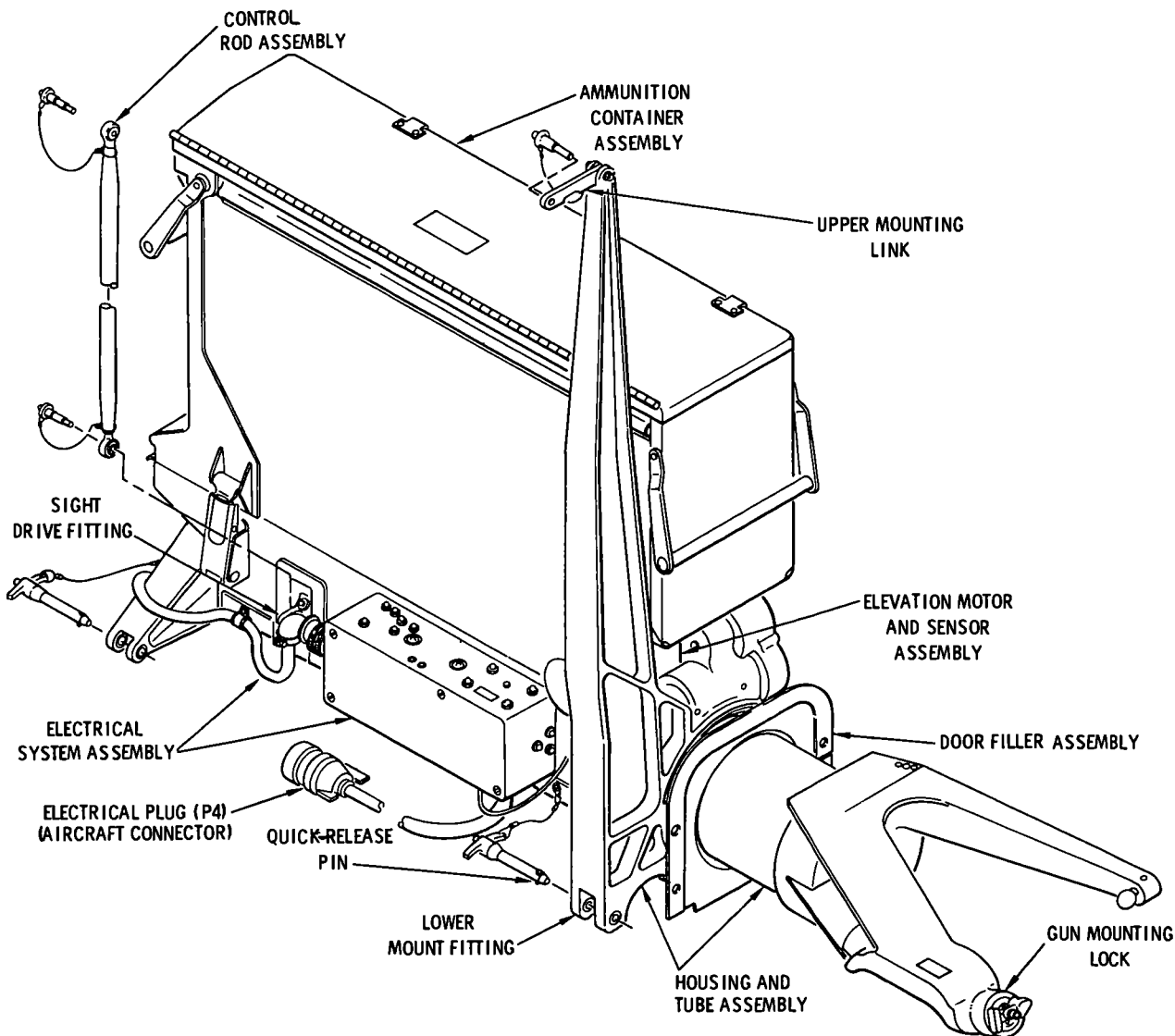


Figure 10-14. Mount assembly.

three spring-loaded ammunition levelers in each of two compartments. Rollers and an integral crossover chute direct linked ammunition into a mating elbow shaped chute on the housing. The lower forward leveler assembly is provided with an actuating block which extends through the bottom of the container to actuate the ammunition low sensor switch. The ammunition container assembly mounts on top of the housing by means of two alining pins, a rectangular shaped locator block, and two latches (fig 10-15).

(3) *Electrical system assembly.* The electrical system assembly consists basically of the control box assembly and the gun drive cable. The control box assembly is mounted on the front side of the housing assembly and provides electrical control functions and electrical distribution required by the subsystem. The gun drive cable provides electrical connection between the control

box assembly and the gun drive control assembly. The gun drive cable consists of a six conductor harness with two electrical connectors.

(4) *Housing and tube assembly.* The housing and tube assembly is a rectangular sheet aluminum structure into which castings are riveted for bearing support and mounting points. It is secured to the helicopter at three points by means of quick-release pins. The assembly is provided with bearings which contact a bearing surface around the tube assembly on which the gun is mounted. Rotation of the tube within the housing provides the elevation and depression of the weapon. Rotation is accomplished by an electric motor-driven clutch and worm gear mating with a gear segment on the tube assembly. The elevation motor assembly is mounted on the housing and includes an ammunition low sensor switch. On the OH-6A helicopter, stops are provided on the gear segment

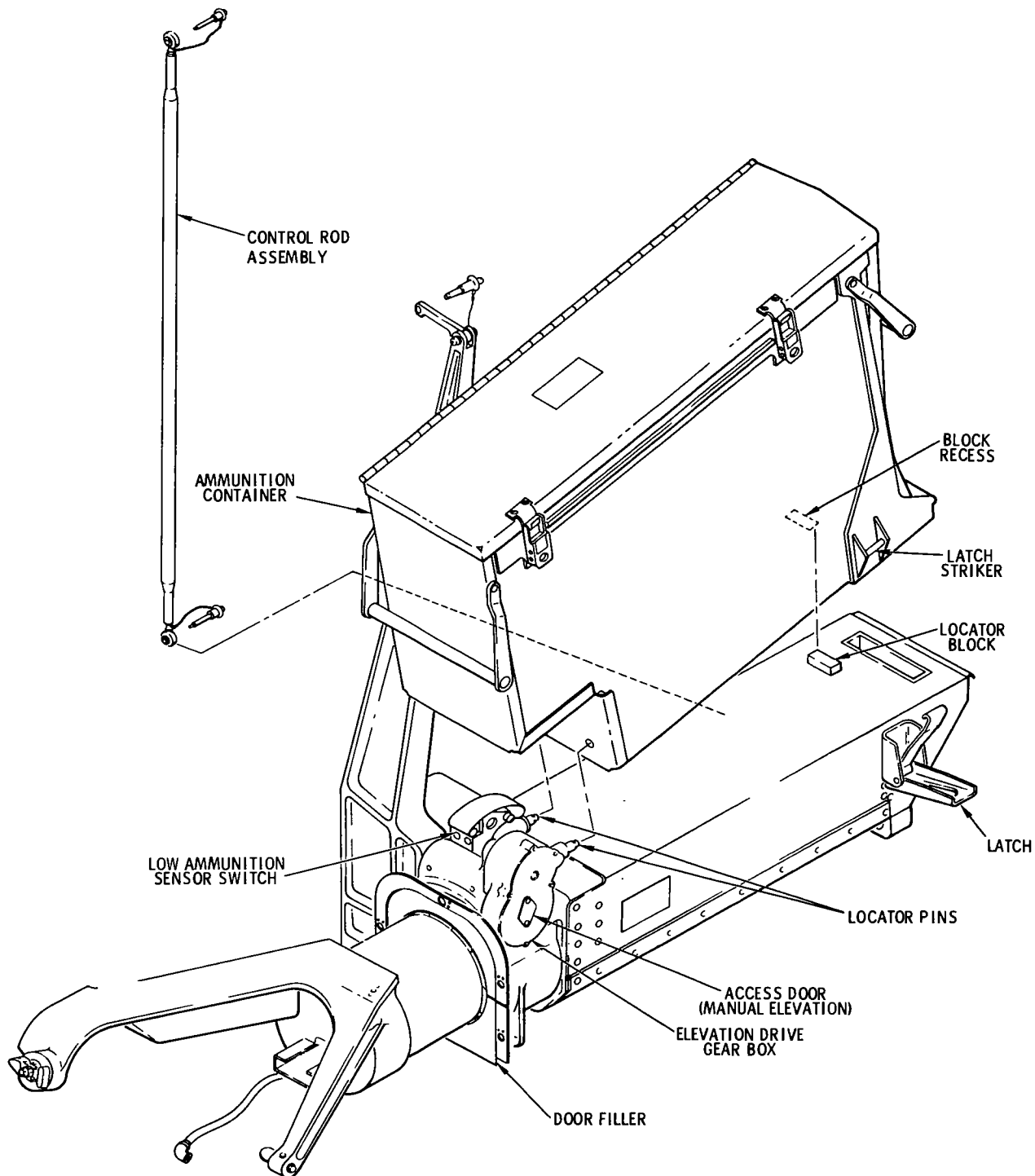


Figure 10-15. Mount assembly—partially exploded view.

to limit elevation to 10° and depression to 24° ; on the OH-58A helicopter, elevation to $5\frac{1}{2}^{\circ}$ and depression to 20° . A sight drive fitting, part of the tube assembly, is provided for attachment of the sight control rod. An ammunition chute adapter assembly and a torsionally flexible aluminum feed chute are mounted in the tube assembly. Ammunition, from the ammunition container assembly, passes through the adapter assembly and ammunition feed chute to the delinking feeder.

(5) *Control rod assembly.* The control rod assembly provides a link between the tube assembly of the housing and tube assembly and the sight assembly. Thus, movement of the tube assembly in elevation and depression causes corresponding movement of the sight assembly.

d. *Helicopter Reflex Sight XM70E1* (fig 10-16). The helicopter reflex sight XM70E1 is an optical sighting instrument synchronized with the

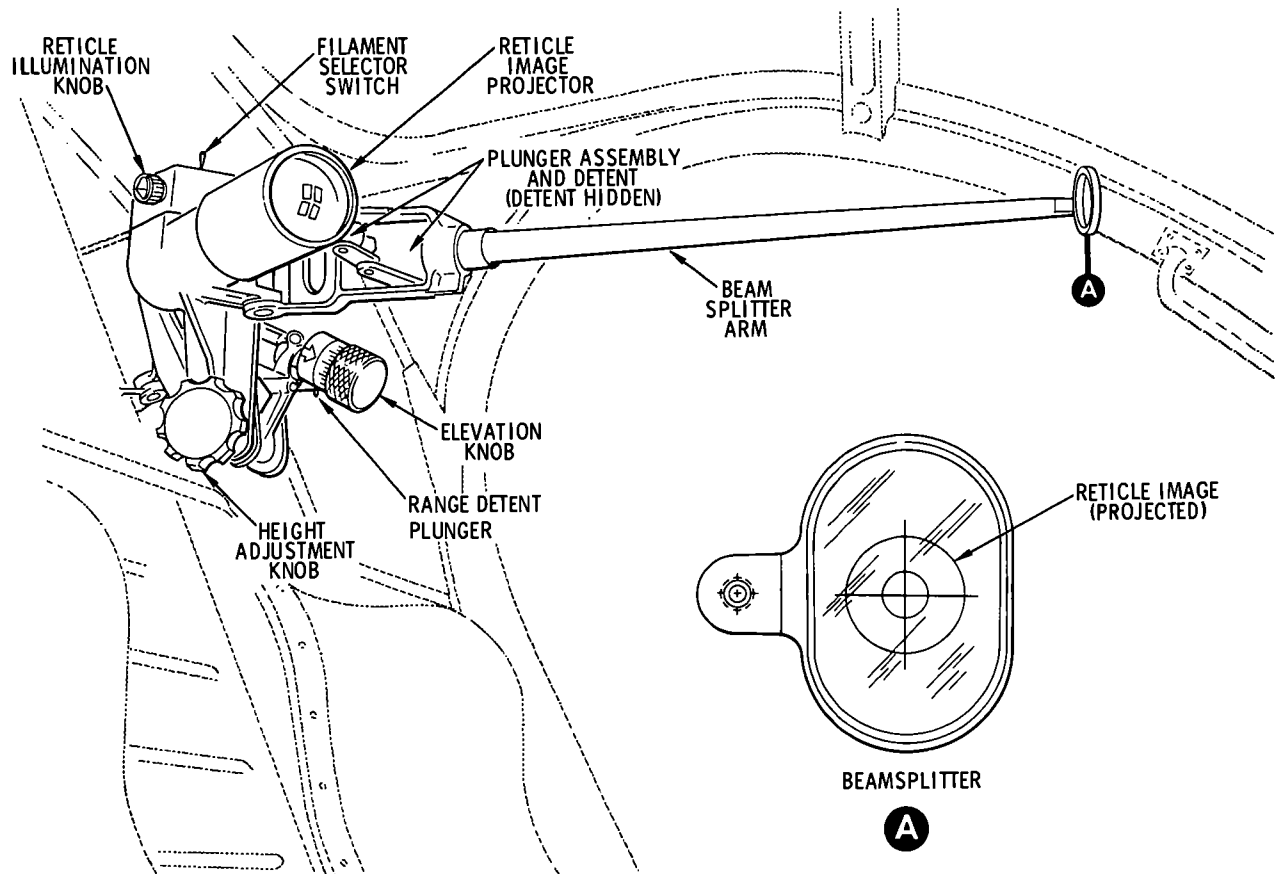


Figure 10-16. Helicopter reflex sight XM70E1.

movement of the weapon in elevation and depression by a control rod. The sight is adjustable in elevation for ranges of 250 to 1,000 meters. The sight mount can be adjusted and locked to a height convenient to the user. A reticle image projector and a beamsplitter plate provide a reticle image that appears superimposed on the target when the weapon is properly aimed. Electrical power for the projector is supplied through a cable connected to the control box assembly. The beamsplitter arm is moved to the left to its stowed position when the sight is not being used.

e. The Beamsplitter Arm. This arm is moved to the left to its stowed position when the sight is not being used.

10-2. Armament Subsystem Controls

a. Electrical Console and Circuit Breaker Panel (fig 10-17). Control for external or battery power is provided through the BATT-OFF-EXT (electrical power) switch, the ARM POWER circuit breaker (50 amps), and the ARM circuit breaker (10 amps). Power is 28-volts DC. Additionally, brightness of the armament panel edgelights is controlled by the SW PANEL, a rheostat type switch, on the LIGHTS panel.

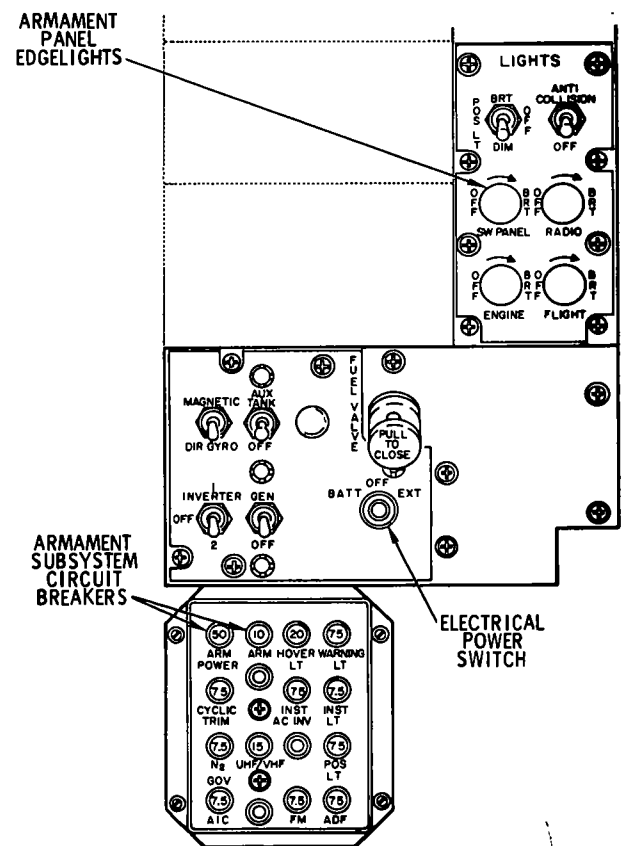


Figure 10-17. Electrical console and circuit breaker panel.

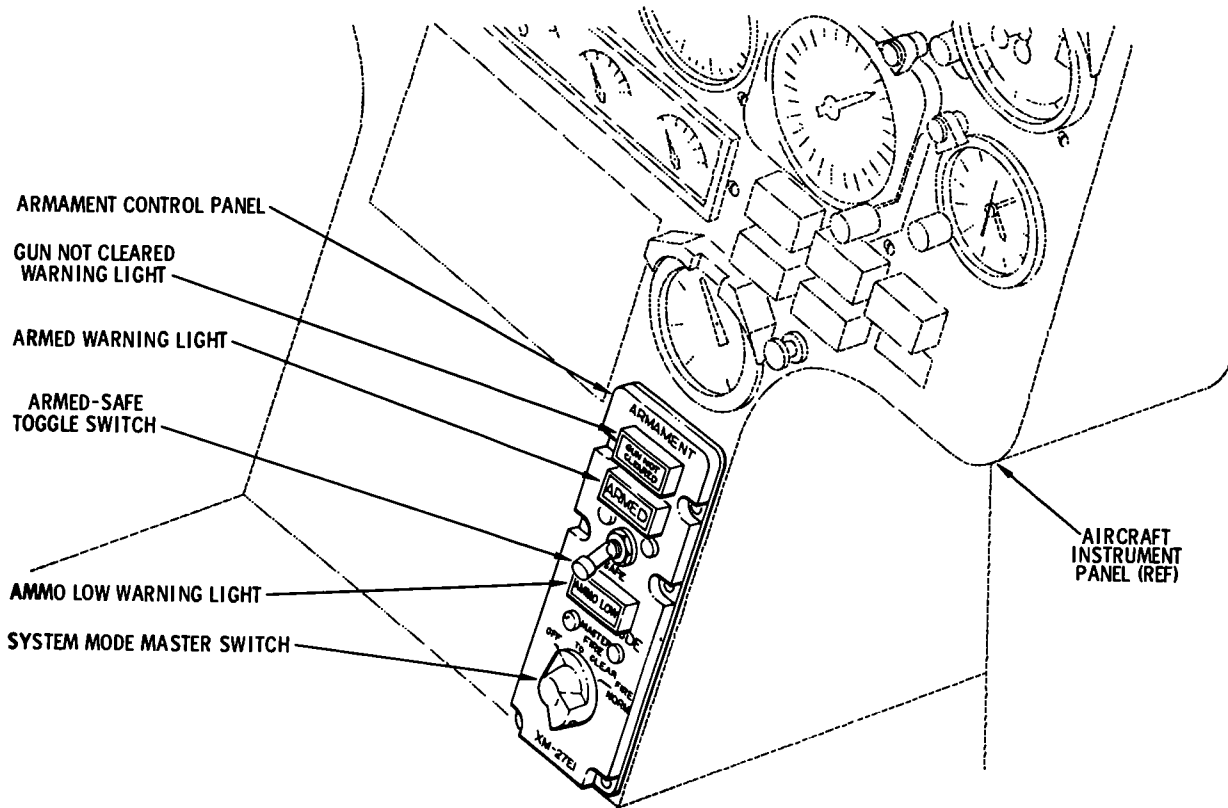


Figure 10-18. Armament control panel.

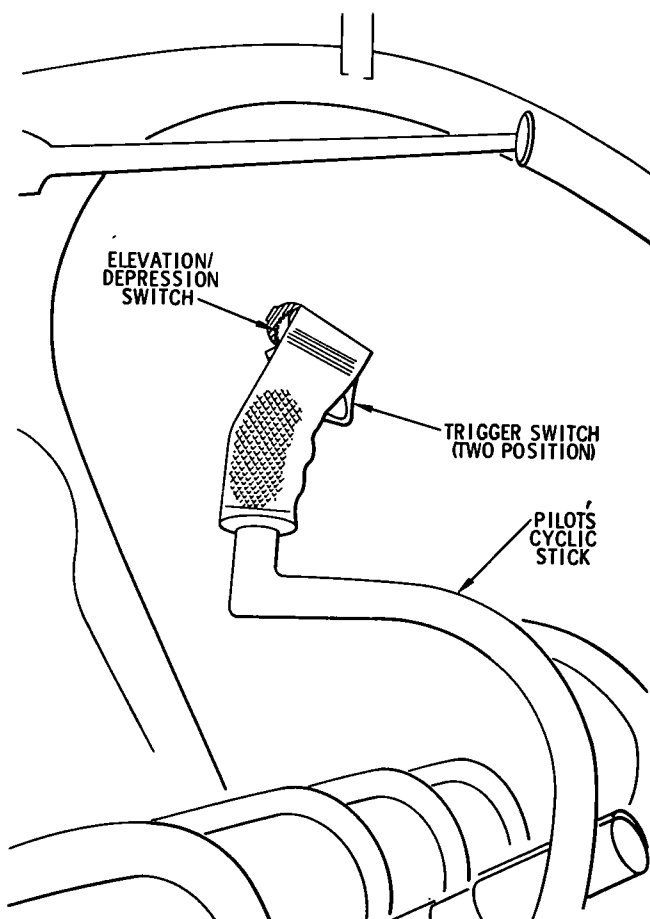


Figure 10-19. Cyclic stick switches.

b. *Armament Control Panel (fig 10-18).* The armament control panel provides the following warning lights: GUN NOT CLEARED, ARMED, and AMMO LOW. The SYSTEM MODE MASTER, a rotary type switch, provides for selection of OFF, FIRE TO CLEAR, and FIRE NORM positions and controls power application to the ARMED-SAFE switch. The ARMED-SAFE switch is a two position, safety toggle type and permits selection of the ARMED position only after the toggle is pulled outward. Power is applied to the pilot's trigger switch when the switch is in the ARMED position.

c. *Cyclic Stick Switches (fig 10-19).* The trigger switch, a guarded type, is located on the forward side of the pilot's cyclic stick group. The switch is pressed to a first or second position, providing a low rate of fire (2,000 spm) in the first position and a high rate of fire (4,000 spm) in the second position. The switch is safe and inactive until the system is armed. The ELEV-DEP switch is a sliding type located on the upper aft side of the pilot's cyclic stick grip. The switch is moved forward to depress the gun and aft to elevate the gun. The spring loaded center position is off. Power is applied to the switch when the aircraft electrical system is energized and the ARM circuit breaker is depressed.

10-3. Tabulated Data—Armament**a. Armament Subsystem M27E1.**

- (1) Weight (subsystem w/o ammunition) 106 lb max.
- (2) Weight (subsystem w/ammunition w/o spare can) 234 lb max.
- (3) Weight (subsystem w/ammunition w/ spare can) 245 lb max.
- (4) Gun (including delinking feeder solenoid with wires) 46.46 lb
- (5) Sight (with mount) 4.71 lb
- (6) Mount (without gun) 31.82 lb
- (7) Ammunition can 9.94 lb
- (8) Link chute 0.94 lb
- (9) Gun drive 6.91 lb
- (10) Sight control central rod assembly 0.5 lb
- (11) Door filler assembly 0.11 lb
- (12) Ram air duct 1.5 lb
- (13) Cartridge ejection chute 0.72 lb
- (14) Ammunition capacity 2000 rd
- (15) Elevation limits: *OH-58A* *OH-6A*
Elevated 5½° 10°
Depressed 20° 24°
- (16) Azimuth control — Maneuver Aircraft

b. Machinegun M134.

- (1) Caliber 7.62mm
- (2) Cooling Air
- (3) Rate of fire: Low 2000 spm
High 4000 spm
- (4) Feed M13 type, linked bolt
- (5) Muzzle velocity 2850 fps
- (6) Rotation of barrels (Viewed from breech end) Counterclockwise
- (7) Weight 35 lb
- (8) Barrel life 100,000 rd

c. Drive Assembly.

- (1) Type Electric motor, dual speed
- (2) Speed control Electronic switch

d. Sight, Reflex XM70E1.

- (1) Length (with mount) 36 in.
- (2) Width (extended) 10 in.
- (3) Width (stowed) 14 in.
- (4) Height 9 in.
- (5) Weight (with mount) 4.8 lb
- (6) Type Collimated, illuminated reticle
- (7) Projection lamp Dual filament
Reticle:
Line width 1 mil
Outer circle diameter 60 mil
Inner circle diameter 30 mil
- (8) Optical characteristics:
Clear aperture 0.94 x 1.4 in. (Beam-splitter)
Objective EFL 4.0 in. nominal

e. Armament Subsystem Electrical Characteristics.

- (1) Nominal operating voltage 28VDC
- (2) Drive motor (steady state):
Slow rate max 40 amp
Fast rate max 75 amp
- (3) Sight lamp 0.68 amp (each filament)
- (4) Operable temperature ranged —65° F to +165° F

f. Ammunition Authorized.

- (1) 7.62mm ball cartridge M59 (NATO).
- (2) 7.62mm ball cartridge M80 (NATO).
- (3) 7.62mm tracer cartridge M62 (NATO).
- (4) 7.62mm armor piercing cartridge M61 (NATO).
- (5) 7.62 mm dummy cartridge M172 (inert loaded).

Caution: Do not use fluted case dummy cartridges.

10-4. Name, Caution, and Instruction Plates Refer to table 10-1.

Table 10-1. Name, Caution, and Instruction Plates

Name	Function or use	Location and/or reference
Identification plate	Nomenclature and serial number	On mount assembly housing.
Control box identification plate	Nomenclature and serial number	On bottom of control box.
Wiring diagram decal	Control box wiring diagram	On control box cover.
Helicopter reflex sight XM70E1 identification decal.	Nomenclature and serial number	On side of projector housing.
Ammunition box loading procedure	Shows proper method of folding ammunition into ammunition container.	On inside of ammunition container cover.
Caution decal	Caution regarding opening of ammunition container.	On ammunition container cover.
Delinking feeder MAU-56/A identification plate.	Nomenclature and serial number	Between mounting lugs at front of delinking feeder.

Table 10-1. Name, Caution, and Instruction Plates—Continued

Name	Function or use	Location and/or reference
Delinking feeder MAU-56/A instruction plate.	Depicts the correct position of cartridges and links when entering feeder.	On forward curved surface of the housing.
Drive motor identification	Nomenclature and serial number	On side of motor.
No step decal	Designates no step area	On upper fairing assembly.
Caution decal	Caution regarding removal of fairing assembly.	On upper fairing assembly.
Warning decal	Warning regarding rotation of barrels	On gun support cradle.
Caution decal	Caution regarding sight removal	On sight support assembly.
Weapon serial number	Weapon identification	On rotor face.

Section II. CONTROLS AND INSTRUMENTS

10-5. General

This section describes, locates, illustrates, and furnishes essential information pertaining to the various controls and indicators provided for the proper operation of the subsystem.

10-6. Controls and Indicators

All primary controls for the subsystem are lo-

cated in the pilot's compartment of the aircraft. Some of the controls, which are permanent components of the aircraft, are described in paragraph 10-2. The subsystem does not include instruments; however, table 10-2 lists and describes the function of indicating lights and all units that perform any type of control with which the operator should be familiar.

Table 10-2. Controls and Indicators

Control or instrument	Function	Reference
7.62MM MACHINEGUN M134		
Timing pin	Used to establish the firing cycle of the gun	Fig 10-20.
Safing sector	When safing sector is removed, bolt assemblies cannot be cammed into battery or firing pins cocked and released by rotation of the gun mechanism.	Fig 10-4.
DELINKING FEEDER MAU-56A		
Timing pin	Used in conjunction with gun timing pin to synchronize ammunition feed with firing cycle of the gun.	Fig 10-21.
Gun clear sensor	Senses rounds cleared from delinking feeder during gun clearing operation.	Fig 10-21.
MOUNT ASSEMBLY		
Low ammunition sensor switch	Illuminates a light on armament control panel indicating less than approximately 400 rounds of ammunition remaining.	Fig 10-15.
Reset button	Resets counter (gun cleared logic module) in control box to extinguish GUN NOT CLEAR warning light. Use only after a manual clearing operation has been accomplished.	Fig 10-22
Manual elevation control	Access door in elevation gearbox cover allows manual elevator or depression using a 1/4-inch socket wrench handle.	Fig 10-15.
ARMAMENT CONTROL PANEL AND CYCLIC STICK SWITCHES		
SYSTEM MODE MASTER switch	Provides mode selections of OFF, FIRE TO CLEAR, and FIRE NORM. Operation in fire to clear mode is used to clear the gun by preventing gun feeding and by ejecting the live rounds. Operation in fire normal mode or fire to clear is limited to 3.0 second bursts when the trigger is depressed.	Fig 10-18.
ARMED/SAFE switch	ARMED position makes the system fully operable	Fig 10-18.
ARMED light	When illuminated, indicates system is in armed condition and will fire when trigger is depressed.	Fig 10-18.

Table 10-2. Controls and Indicators—Continued

Control or instrument	Function	Reference
ARMAMENT CONTROL PANEL AND CYCLIC STICK SWITCHES—continued		
GUN NOT CLEARED light	When illuminated, indicates that less than seven live rounds have been cleared from the delinking feeder and that ammunition may remain in the gun, consequently the gun will fire if manually rotated. Warning: When the GUN NOT CLEARED light is extinguished, the weapon will not fire during manual rotation; however, if the trigger is depressed the weapon will immediately chamber a round and fire.	Fig 10-18.
AMMO LOW light	When illuminated, indicates less than approximately 400 rounds remaining.	Fig 10-18.
Elevation depression switch	Provides pilot and/or copilot with control of elevation and depression of weapon (can be operated any time aircraft electrical power is on and ARM circuit breaker is depressed).	Fig 10-19.
Trigger switches (on cyclic stick grips) ..	Permits pilot or copilot to fire at 2,000 spm (on first detent) or 4,000 spm (on second detent).	Fig 10-19.
HELICOPTER, REFLEX SIGHT XM70E1		
Height adjusting knob	Permits sight to be moved up or down and locked in place for height adjustment.	Fig 10-16.
Plunger assembly and detent	Provides a means for locking the sight in operating position.	Fig 10-16.
Elevation knob	Used to set the estimated range into the sight. Clockwise rotation elevates the sight.	Fig 10-16.
Range detent plunger	Provides a means of locking the elevation control assembly in the appropriate range scale and provides an audible click at each range setting.	Fig 10-16.
Reticle illumination knob	Controls the intensity of the reticle pattern. Clockwise rotation increases the light intensity (MODE MASTER switch at FIRE TO CLEAR OR FIRE NORM).	Fig 10-16.
Filament selector switch	Provides switching for dual filament reticle projector lamp. If light fails during operation, the second filament can be selected by throwing the switch to the opposite position. Normal switch position is forward.	Fig 10-16.
Boresight adjustment screw	Provides azimuth adjustment.	Fig 10-23.

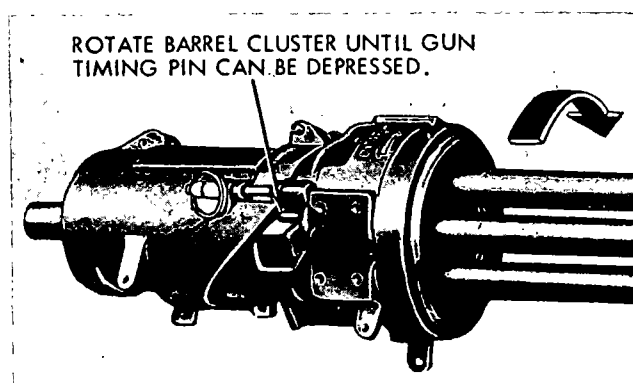


Figure 10-20. Timing the gun.

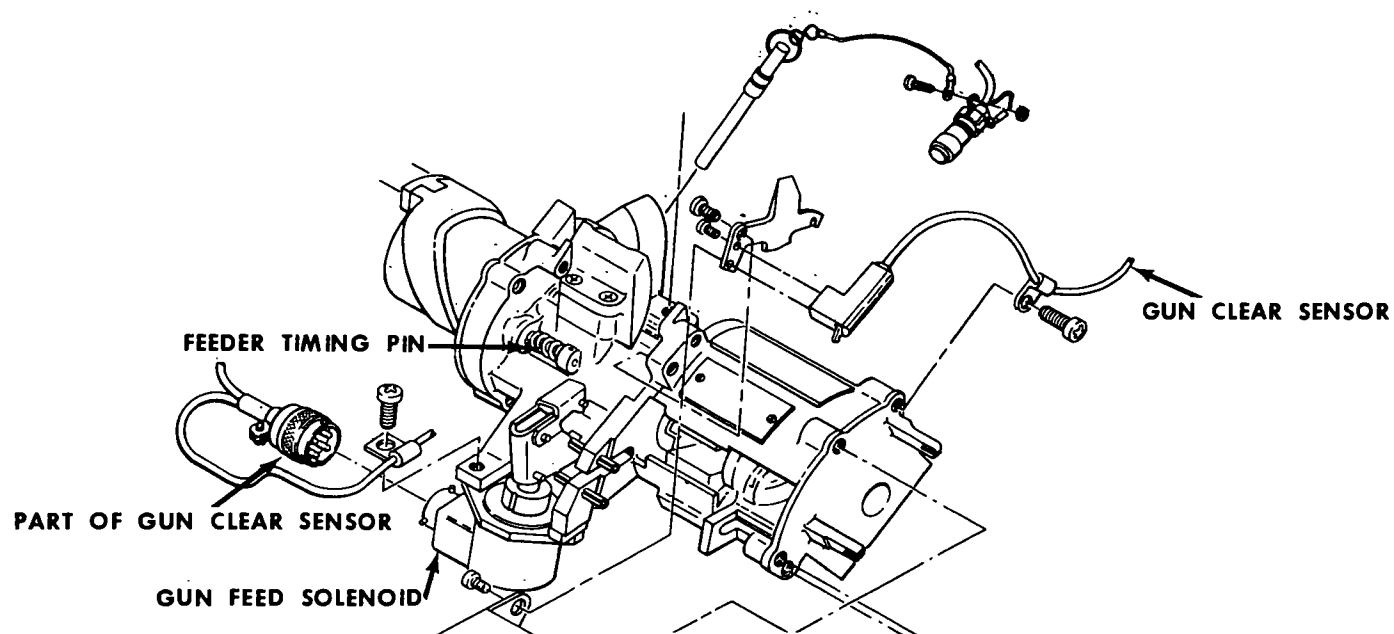


Figure 10-21. Delinking feeder MAU-56/A timing pin and gun clear sensor.

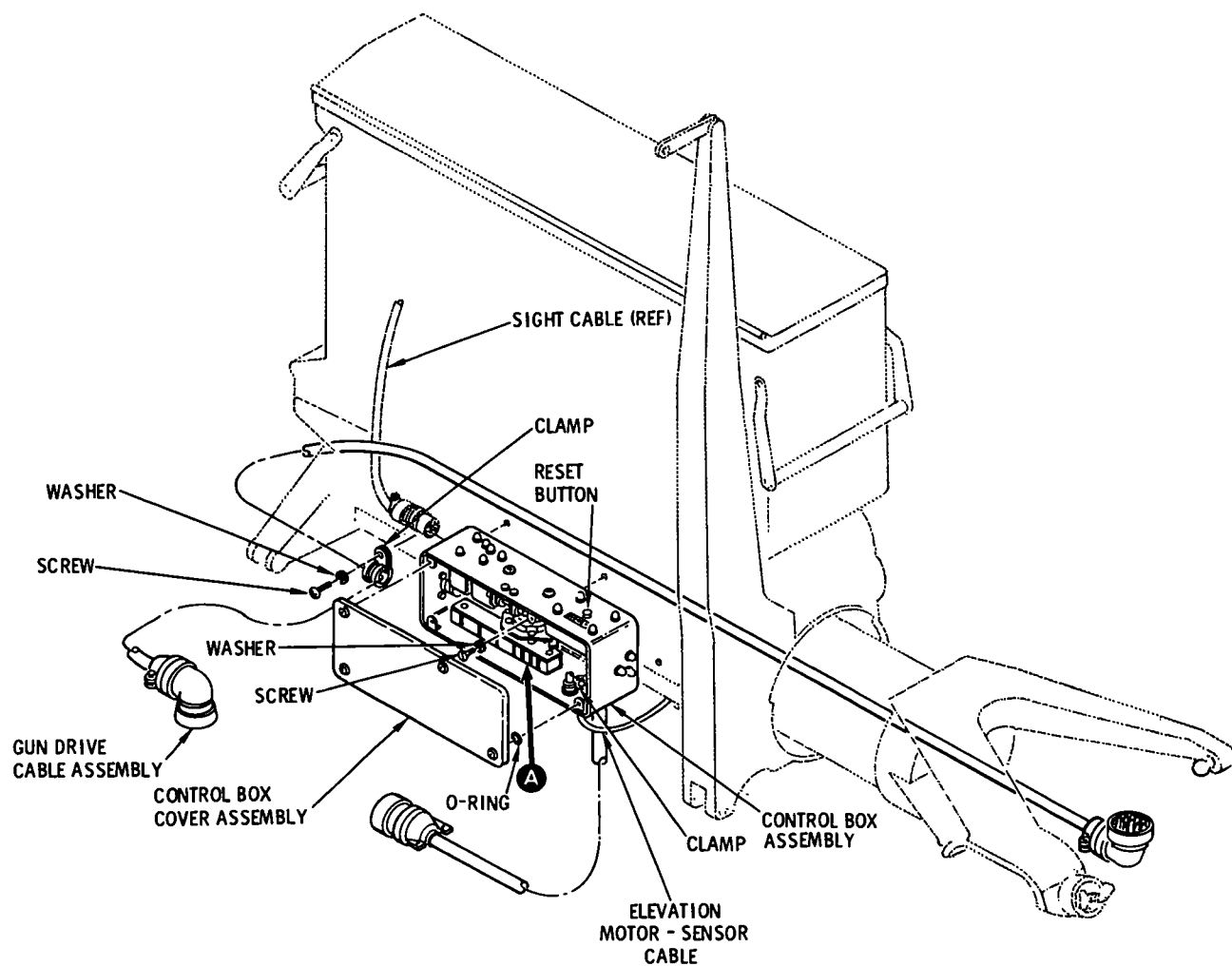
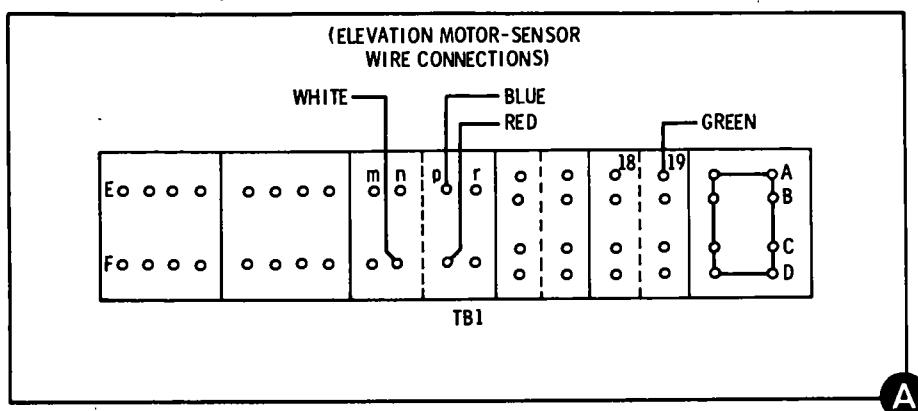


Figure 10-22. Electrical system assembly—partially exploded view.

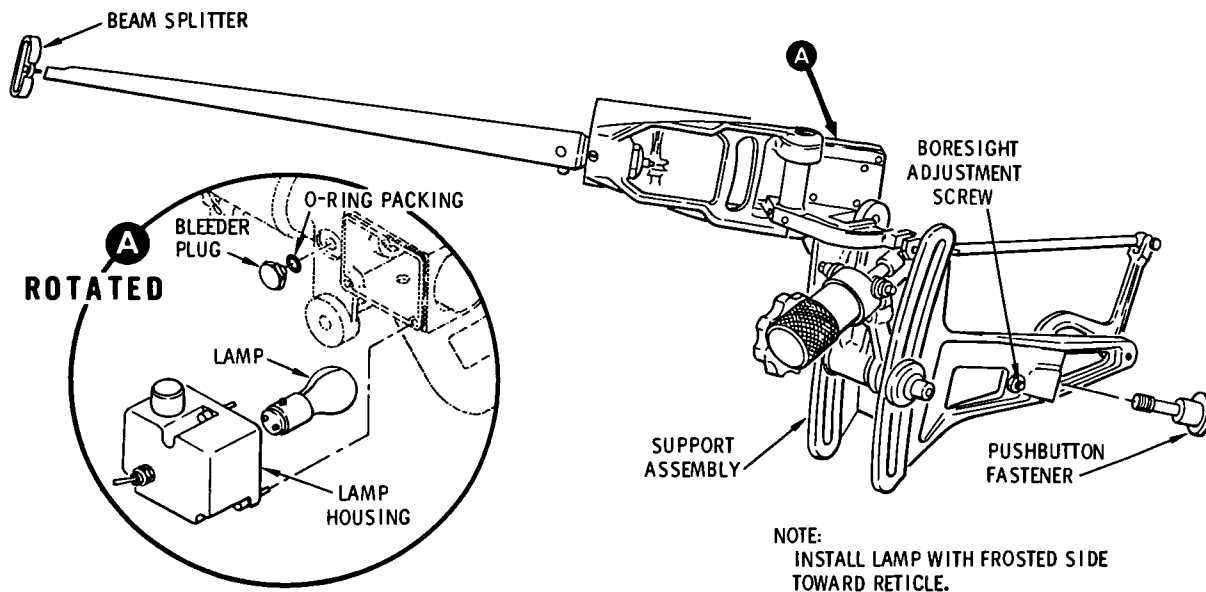


Figure 10-23. Reflex sight XM70E1—partially exploded view.

Section III. OPERATIONAL CHECKS

10-7. General

Perform operational checks when specified during

preventative maintenance (table 10-3) and when directed in other procedures in this manual.

Table 10-3. Operational Checks

Check sequence	Control	Operation and check	Fig No.
1	ARMED/SAFE switch.....	Place in SAFE position.....	10-18
2	SYSTEMS MODE MASTER switch.....	Place in OFF position. GUN NOT CLEARED, ARMED, AND AMMO LOW lights should be out.	10-18
8	SYSTEM MODE MASTER switch.....	Place in FIRE TO CLEAR position. AMMO LOW light illuminates. GUN NOT CLEARED and ARMED lights should be out.	10-18
4	ARMED/SAFE switch.....	Pull out switch and place in ARMED position. ARMED light illuminates.	10-18
5	Cyclic stick trigger switch.....	Press trigger to fire, either 2,000 or 4,000 spm position. Gun rotates for approximately 8 seconds. GUN NOT CLEARED light illuminates.	10-19
6	SYSTEM MODE MASTER switch.....	Place in FIRE NORMAL position.....	10-18
7	Cyclic stick trigger switch.....	Press trigger to fire. GUN NOT CLEARED light remains on. Gun rotates approximately 3 seconds if trigger is held down.	10-19
8	SYSTEM MODE MASTER switch.....	Place in FIRE TO CLEAR position.....	10-18
9	Cyclic stick trigger switch.....	Press trigger to fire, then immediately release. Gun rotates for approximately ¼-second after trigger is released. Gun NOT CLEARED light will remain on since seven rounds of ammunition must be expelled to activate the gun cleared logic circuit. Press RESET button on control box to extinguish GUN NOT CLEARED light.	10-19
10	ARMED/SAFE switch.....	Place in SAFE position.....	10-18
11	SYSTEM MODE MASTER switch.....	Place in either FIRE TO CLEAR or FIRE NORMAL position.	10-18
12	Reflex sight filament selector switch.....	Place in either filament position. Reticle lamp comes on. Switch to other filament position. Reticle lamp comes on. Return switch to the forward position.	10-16
13	Reflex sight reticle illumination knob.....	Rotate knob. Intensity of light should increase when turning clockwise.	10-16
14	Reflex sight elevation knob.....	Rotate knob to increased range, sight depresses. Rotate knob to low range, sight elevates.	10-16
15	Cyclic stick elevator/depression switch.....	Push aft on switch, weapon and sight elevate. Push forward on switch, weapon and sight depress.	10-19

Table 10-3. Operational Checks—Continued

Check sequence	Control	Operation and check	Fig No.
16	Low ammunition sensor switch.....	Open cover on ammunition container and depress the lower forward ammunition leveling assembly. AMMO LOW light goes out.	10-15
17	SYSTEM MODE MASTER switch...	Place in OFF position. Check that gun is depressed so it will not interfere with the copilot's door if opened. Turn off helicopter 28 volts dc supply.	10-18 10-17

10-8. Operational Check—Power Off

a. Remove fairing assembly (fig 10-1).

(1) Remove lower fairing assembly by disengaging seven turnlock fasteners attaching it to the upper fairing assembly.

(2) Remove upper fairing assembly by disengaging three turnlock fasteners attaching it to the mount assembly.

Caution: When removing upper fairing assembly, be sure to unlatch the hidden fastener inside and at the rear of the fairing assembly.

b. Rotate barrel cluster until gun timing pin can be depressed; simultaneously depress gun and delinking feeder timing pin.

c. Manually clear at least five dummy rounds through delinking feeder; check that moving parts operate smoothly, dummy rounds are ejected without binding or catching, and brass is not dented.

d. Manually cycle at least 10 dummy rounds through weapon; check that moving parts operate smoothly, dummy rounds transfer without binding or catching, and brass is not dented.

e. Install fairing assembly (fig 10-1).

(1) Install upper fairing assembly by engaging three turnlock fasteners attaching it to the mount assembly.

(2) Install lower fairing assembly by engaging seven turnlock fasteners attaching it to the upper fairing assembly.

10-9. Operational Check—Power On

Warning: Do not attempt to perform operational checks with ammunition present in gun, delinking feeder, ammunition chutes, or container.

a. Connect 28-volt dc power to the aircraft and place BATT-OFF-EXT switch at EXT.

b. Depress ARM and ARM POWER circuit breakers.

Caution: Gun operation without ammunition (dry firing) shall be held to a minimum to avoid damaging firing pin. The gun safing sector must be installed to prevent gun jamming and damage to bolt assemblies.

c. Refer to table 10-3 for check procedure. See figures referenced for location of controls.

Section IV. BORESIGHTING

10-10. General

Boresighting should be accomplished under the following circumstances:

a. When reports of firing missions indicate that a boresighting discrepancy may exist.

b. After installing a new or used armament subsystem.

c. After repair, replacement, or a change in length of the control rod assembly.

10-11. Boresighting—Distant Aiming Point Method

Warning: All ammunition must be removed from all parts of the subsystem prior to boresighting.

a. Select a well defined point target at a distance of 750 meters (820 yd).

Note. In areas where space limitations preclude employing a distance of 750 meters for boresighting, refer to paragraph 10-12 for alternative ranges.

b. Remove lower and upper fairing assemblies if installed (para 10-8a). Time gun by depressing timing pin (fig 10-20); install the adapter (with streamer attached) and boresight (fig 10-24) in the topmost gun barrel (12 o'clock position).

c. Swing aside the small access door (fig 10-15) in the elevation gearbox cover. Use a 1/4-inch socket drive handle through the access opening to manually adjust gun elevation.

Note. An assistant will be required to observe the distant aiming point through the boresight while adjustment is being made.

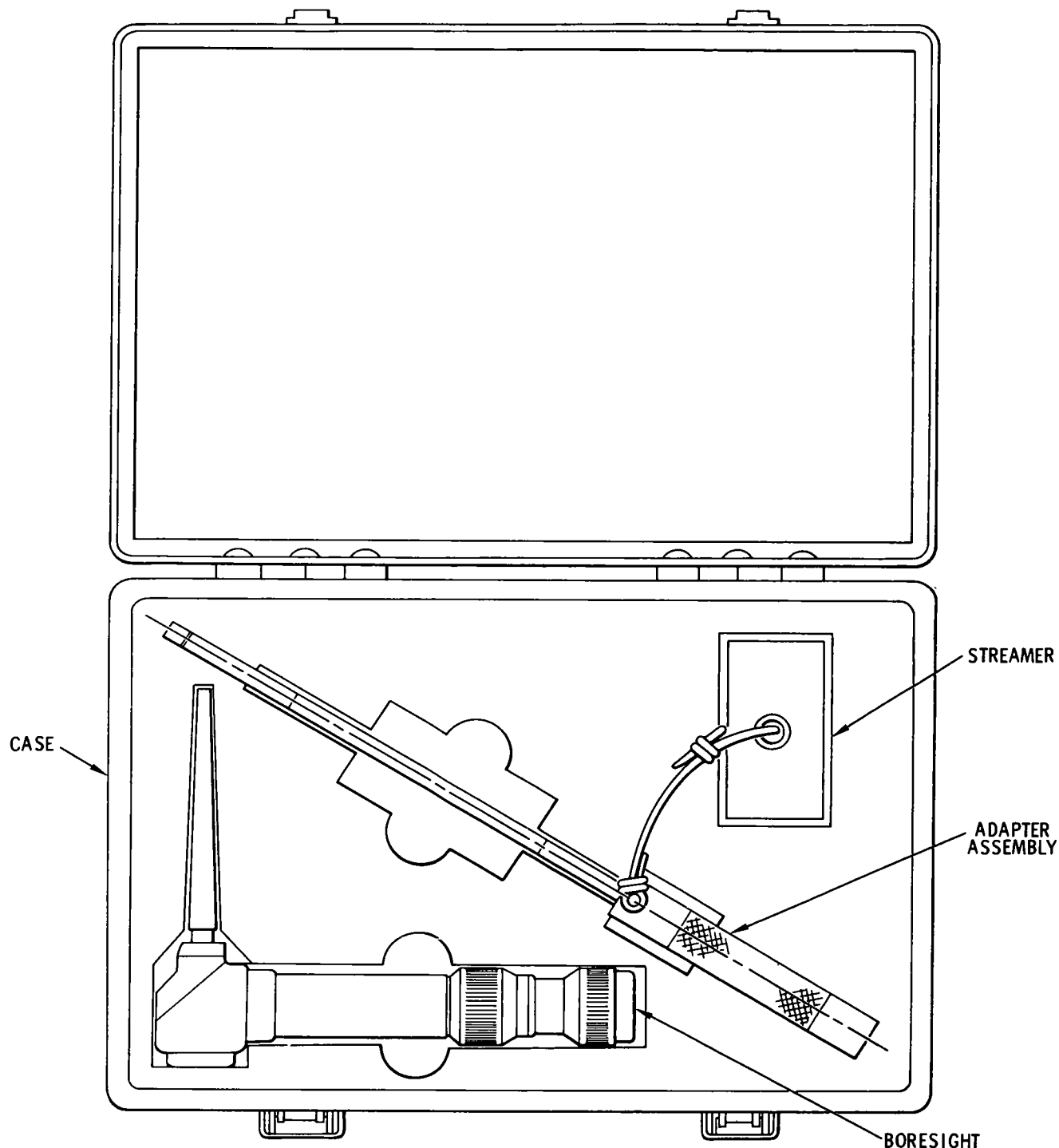


Figure 10-24. Boresight kit.

d. Sighting through the boresight scope, move helicopter laterally on ground-handling wheels until vertical reticle line is centered on target. Adjust gun elevation manually with socket drive handle until the horizontal reticle line is centered on the target.

Note. Helicopter leveling is not required, but cant angle should be as small as possible. Weapon elevation position not critical and can be at the elevation required to acquire the point target, but should be kept as near horizontal as practical.

e. Aline 750 on the white scale of the elevation know (fig 10-16) with the white arrow. The sight is now in boresighting position.

f. Place both the ARM and the ARM POWER circuit breakers (fig 10-17) in the on position. Place BATT-OFF-EXT switch at BATT (fig 10-17) and SYSTEM MODE MASTER switch (fig 10-18), at FIRE TO CLEAR to illuminate reticle pattern.

g. Position height of sight for convenient observation of the reticle pattern. Adjust reticle illumination knob (fig 10-16) for proper reticle intensity.

h. Loosen pushbutton fastener and adjust bore-sight adjustment screw (fig 10-23) until the center of the reticle image pattern is coincident with a vertical line running through a point four reticle line widths (2.6 meters) to the left of the point target, as described in step d. Tighten pushbutton fastener stud. Recheck reticle image pattern to make sure the position has remained fixed.

i. Remove sight electrical cable from clips on control rod tube assembly (fig 10-14). Manually adjust control rod assembly by turning the tube assembly until center of reticle pattern corresponds with a point three reticle line widths (2.1 meters) below the point target, as described in step d.

j. Recheck to make sure the weapon and the sight still indicate the set points described in steps d, h, and i.

k. Remove the boresight, adapter assembly, and streamer from gun. Place electrical controls actuated in step f above to off position. Install

sight electrical cable, removed in step i above, in control rod assembly clips.

Note. The sight to gun relationship has been optimized for the aircraft in flight (100 knots at 100 ft altitude) and therefore the sight will not indicate the proper impact point under static conditions.

10-12. Boresighting—Short Range Aiming Point Method

When boresight range limitations dictate the use of boresight points closer than 750 meters, the following deviations in the procedure (para 10-11) must be observed.

a. Use the 750 meter setting on the range knob regardless of the boresight point distance.

b. Loosen the height adjustment knob and lower the sight support assembly to the bottom of its travel.

c. Set the sight reticle image to the azimuth value indicated on the azimuth correction curve (fig 10-25) appropriate for the distance to the target used by adjusting the boresight (azimuth) adjustment screw (fig 10-23).

d. Set the sight reticle image to the elevation value indicated on the elevation correction curve

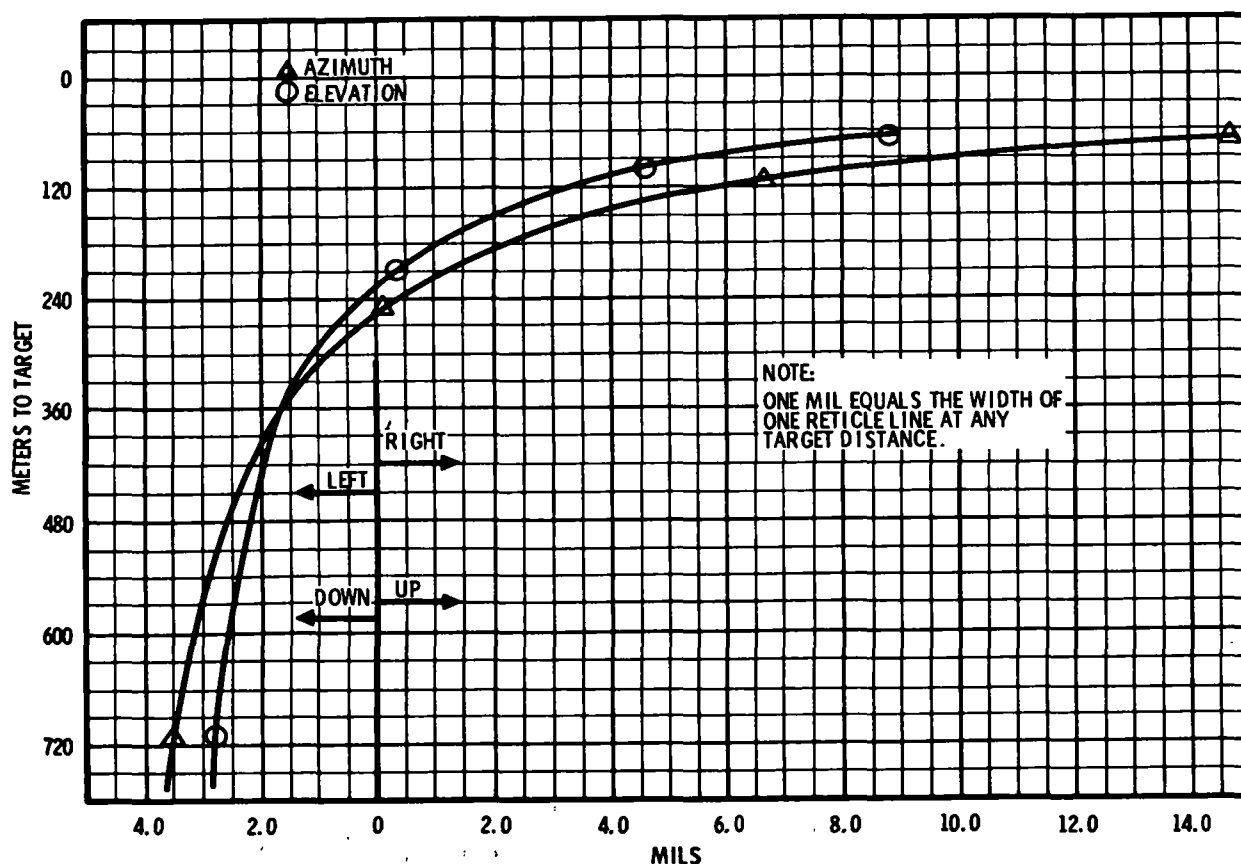


Figure 10-25. Sight-to-boresight relationship for short range targets.

appropriate for the distance to the target used by adjusting length of control rod assembly. These curves compensate for the range setting of 750 meters, the elevation displacement of the sight versus gun, and the similar azimuth displacement, for any range up to 750 meters. Examples (using the correction curves) are as follows:

(1) For a target distance of 120 meters, the sight aim point must be 3.5 mils above and 6.0 mils to the right of the gun boresight point.

(2) For a target distance of 360 meters, the sight aim point must be 1.6 mils below and 1.6 mils to the left of the gun boresight point.

Section V. OPERATIONAL SERVICES

10-13. Preparation for Loading or Unloading

Load and unload the subsystem only in areas designated for such operations. The helicopter should be headed toward a clear area with the gun directed downward. Electrical power is not required and should not be connected. No other work operations, such as aircraft servicing or maintenance, should be performed while the armament subsystem is being loaded or unloaded.

10-14. Loading Instructions

Caution: Loading in excess of 2,000 rounds can cause jamming.

a. Prior to loading the gun, check to make sure the following conditions exist:

(1) Helicopter BATT-OFF-EXT switch OFF.

(2) Armament SYSTEM MODE MASTER switch OFF and ARMED/SAFE switch in SAFE position.

(3) Warning lights out.

b. Fold ammunition belt into ammunition container assembly (fig 10-26) and work it through ammunition chutes to the delinking feeder.

c. Remove fairing assembly from mount assembly (para 10-8a).

NOTES:

1. OPEN SIDE OF LINKS TO BE DOWN  AT BOTTOM STARTING LAYER. OPEN SIDE OF LINKS WILL BE UP  AT FINAL TOP LAYER.

2. TO AVOID HANDLING A COMPLETE LOAD IN A SINGLE LENGTH OF AMMO, DIVIDE INTO TWO EQUAL LENGTHS, LOAD COMPARTMENT A FIRST, THEN AFTER CROSSING OVER TO THE BOTTOM OF COMPARTMENT B, RECONNECT THE SECOND LENGTH TO THE END OF THE FIRST AND COMPLETE LOADING.

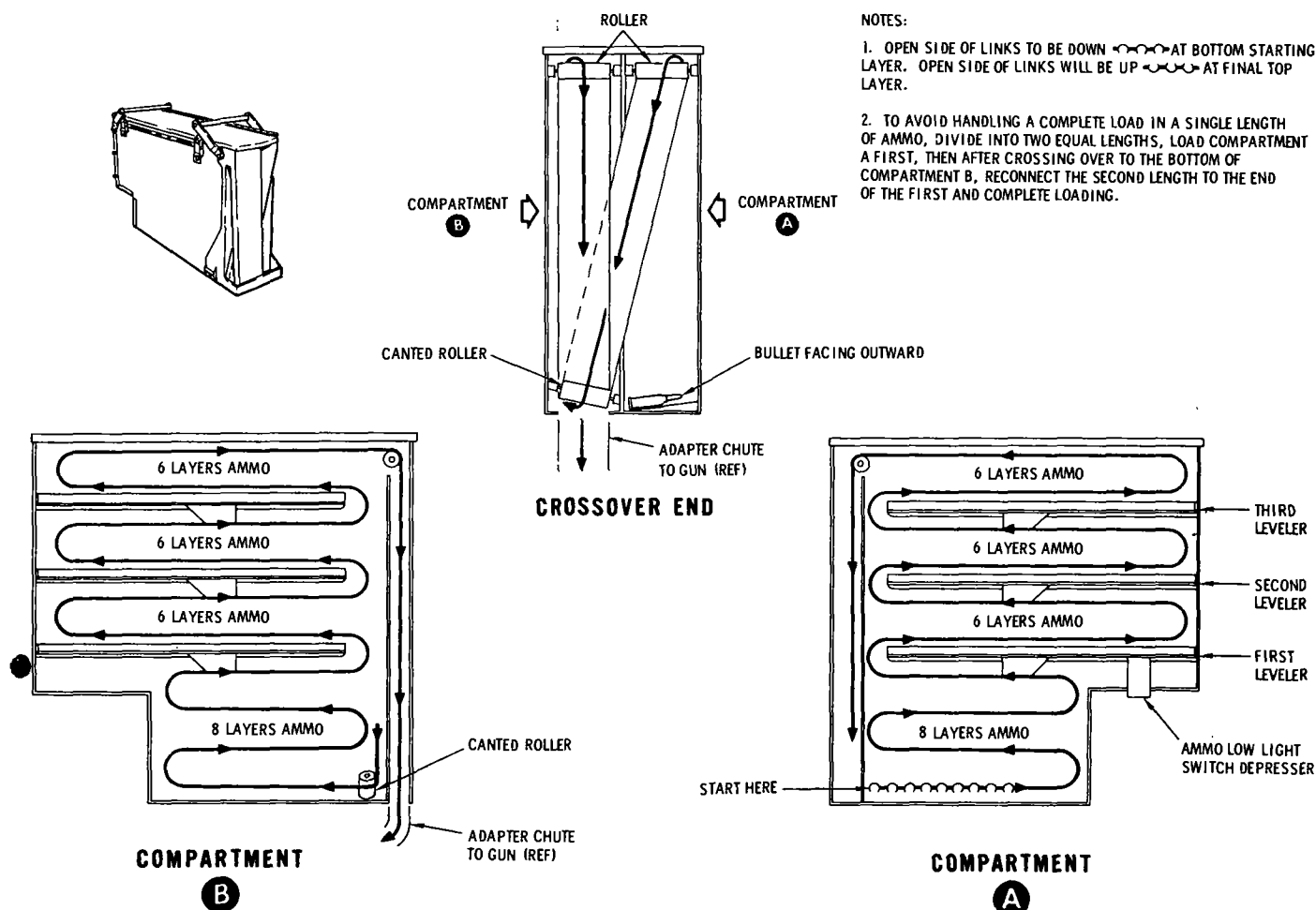


Figure 10-26. Method of loading ammunition container assembly.

d. Remove safing sector and housing cover from gun (para 10-1a(1)(d),(e)).

Caution: Do not force a round into the delinking feeder. The first round will be picked up by feeder rotation.

e. Feed ammunition to delinking feeder by working through open top of ammunition chute.

f. Rotate gun barrels counterclockwise (as viewed from rear of gun) until a round drops from the delinking feeder.

g. Install safing sector and housing cover on gun and install fairing assembly. Close and latch ammunition container assembly cover.

10-15. Unloading and Clearing Instructions

a. Prior to unloading and clearing the gun, check to make sure the following conditions exist:

(1) Helicopter BATT-OFF-EXT switch: OFF.

(2) SYSTEM MODE MASTER switch: OFF.

(3) ARMED/SAFE switch: SAFE.

(4) Warning lights out.

Warning: A firing pin may be cocked and ready to be released. Before removing safing sector and housing cover, rotate barrels clockwise (opposite firing direction) slightly to prevent firing. Failure to adhere to these instructions explicitly can result in discharge of the weapon.

b. Remove fairing assembly (para 10-8a) from mount assembly and remove safing sector and housing cover from the gun (para 10-1a(1)(d),(e)).

c. Release ammunition chute from delinking feeder and remove one cartridge from the linked cartridges.

d. Manually rotate barrels counterclockwise, viewed from breech end (firing direction), until remaining cartridges are cleared from delinking feeder and the gun.

e. Open cover on ammunition container assembly and pull linked ammunition from chutes and into ammunition container assembly. Remove ammunition container assembly if required.



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CHAPTER 11

UH-1B/C/M HELICOPTER ARMAMENT SUBSYSTEM

Section I. M5 40MM RIFLED-BORE ARMAMENT SUBSYSTEM

11-1. Capabilities

a. The M5 helicopter armament subsystem (fig 11-1) launches 40mm antipersonnel fragmentation-type projectiles to provide a neutralization fire capability for UH-1B/C/M helicopters.

b. The maximum rate of fire is 220 shots per minute. The minimum burst is two rounds from a flexible or stow position. The subsystem can fire a single round by rapidly depressing and releasing the firing switch on either cyclic control stick.

c. Maximum employable range is 1,750 meters.

d. Maximum effective range is 1,200 meters.

e. Minimum safe range for firing the M384 cartridge during training is 300 meters; for combat firing, about 100 meters.

f. *Ammunition Capacity.*

(1) If ammunition box fed, 150 rounds.

(2) If ammunition rotary drum fed, 300 rounds.

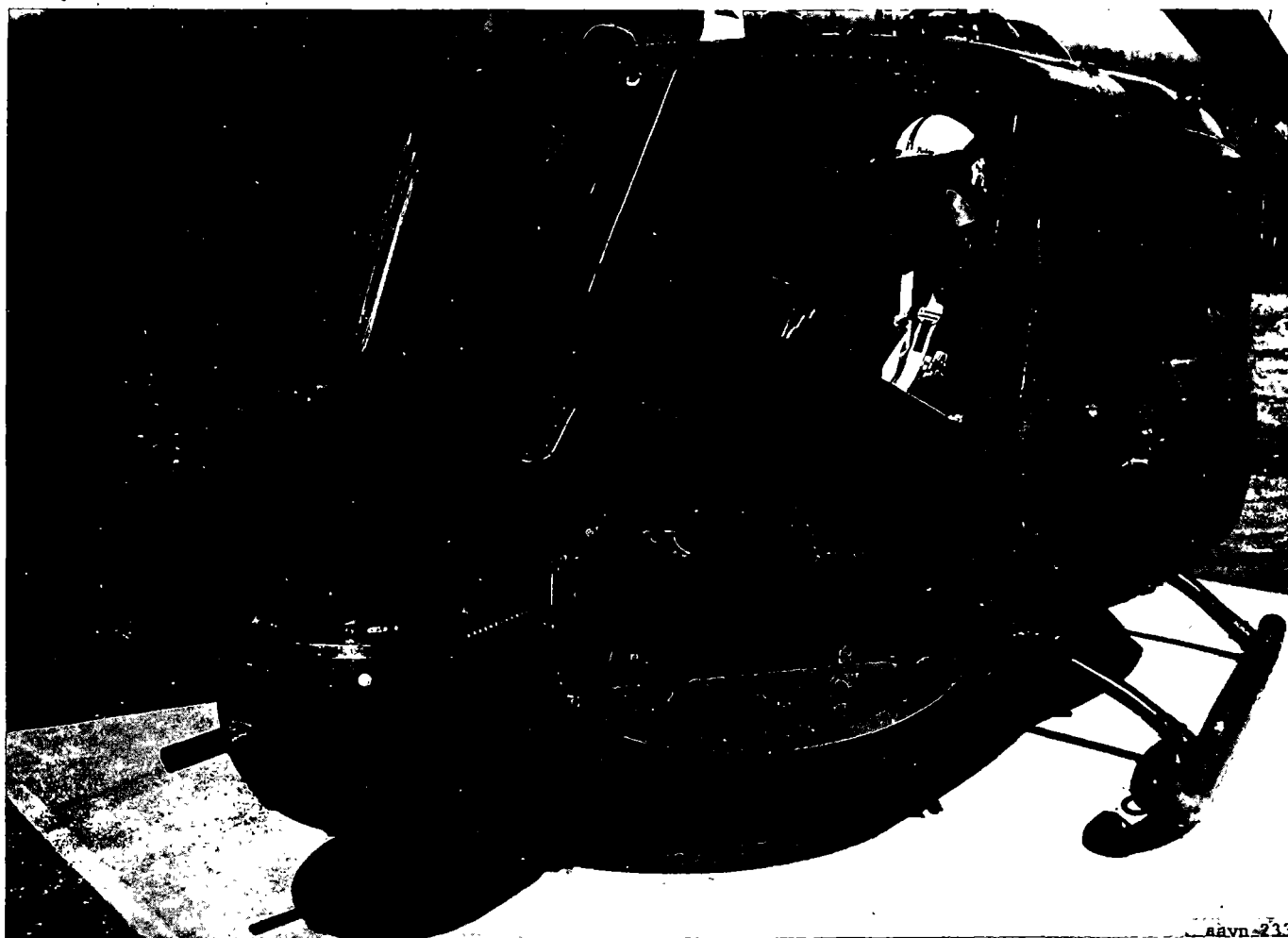


Figure 11-1. M5 armament subsystem.

g. Maximum flexible limits of the mounted gun are—

(1) Azimuth: 60° right, 60° left. (For target lead corrections, see table 11-1).

Table 11-1. Corrections to Target Azimuth (Degrees) to Compensate for Target Lead and Drift or Projectile Versus Aircraft Speed and Azimuth to Target

Aircraft speed (knots)	Azimuth to target (degrees)								
	-60	-45	-30	-15	0	+15	+30	+45	+60
0	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5	-.5
60	-6.3	-5.3	-3.7	-2.0	-.4	+1.2	+2.9	+4.4	+5.5
90	-8.9	-7.3	-5.0	-2.6	-.4	+1.9	+4.3	+6.6	+8.1

Note. Minus (-) indicates an azimuth or correction to the left. Positive (+) indicates an azimuth or correction to the right.

(2) Elevation: +15°, -35°. (For a guide to slant range elevation adjustment, see table 11-2).

h. Daily expenditure of fire is limited only by ammunition resupply and possible time-compliance weapon parts change or maintenance.

11-2. Limitations

The M5 subsystem is vulnerable to all types of air defense fires, including small arms, and has the following limitations:

a. Effectiveness of operation is reduced at night and during periods of low visibility due to limitations in target acquisition and range estimation.

b. Engagement of targets is limited by the subsystem's flexible limits in relation to gun-target range, altitude, airspeed, and helicopter degree of bank.

Table 11-2. Correct Angle of Quadrant Elevation for 90 Knots Airspeed by Slant Range and Altitude

Slant range (meters)	Absolute altitude		
	100 ft	500 ft	1,000 ft
	Correction factor		
	(mils)	(mils)	(mils)
300	5		
400	19	-43	
500	33	-18	
600	47	4	-52
700	61	22	-25
800	75	43	-1
900	90	60	21
1,000	106	78	42
1,100	123	97	64
1,200	142	117	86
1,300	162	138	108
1,400	184	161	131
1,500	208	185	156
1,600	235	211	182
1,700	264	240	210
1,800		272	240
1,900			273

11-3. Safety

Normal safety precautions prescribed in TM 9-1300-206 for handling high-explosive ammunition apply to the M384 cartridge.

Warning: Unexploded M384 projectiles fired from launchers **WILL NOT BE HANDLED OR MOVED UNDER ANY CIRCUMSTANCES.** They will be destroyed by explosive ordnance disposal personnel or other qualified personnel.

Warning: Troops moving into an area that has been subjected to fire from M384 cartridges must be warned that all unexploded projectiles are extremely dangerous and must not be touched or disturbed in any manner.

11-4. Description and Functioning

The M5 helicopter armament subsystem employs a 40mm gun mounted in a flexible power-operated turret on the nose of the helicopter. The gunner aims and fires the gun using a hand control sight assembly (f below). Within the physical travel limitations of the turret, gun control is independent of the helicopter's flight attitude. When the turret control switch (fig 11-8) is released by the gunner, the turret returns to a fixed forward attitude (stow position). Either the pilot or gunner can fire the gun in the stow position by depressing the firing switch located on either cyclic stick. The pilot can preset or control gun elevation in the stow position by adjusting a wheel on the turret control panel assembly. For subsystem weights, see table 11-3.

a. **Turret Assembly.** The turret assembly mounts on three hard points outside the electronic equipment compartment on the helicopter nose. It contains the components which mount, position, and fire the gun. The internal components are protected by both top and forward turret enclosure assemblies. These assemblies are easily removed to provide access to the gun and turret assembly components. The forward enclosure assembly has a rectangular opening for the gun barrel. Closure

brushes, mounted in the rectangular opening, prevent entry of dirt and foreign matter. An external boot assembly attaches to the top enclosure and to the electronic equipment door of the helicopter. It protects the front ammunition chute assembly and the electric cable assembly that connects the turret assembly components with the remainder of the subsystem. Major components of the turret assembly are the—

Table 11-3. M5 Subsystem Weights

Item	Weight (lb)	
	Unloaded	Loaded
M5 subsystem—		
Ammunition box fed.....	233	335 (150 rounds)
Ammunition rotary drum fed	223.5	459 (300 rounds)
Ammunition container—		
Ammunition box and cover assembly.	16	80 (85 rounds)
Ammunition can and access cover assembly.	32	220 (240 rounds)

(1) *Gun drive assembly.* The gun and drive motor are mounted in the saddle assembly. A gun drive assembly transmits mechanical power to the gun through a belt and universal joint. The saddle assembly rotates on the horizontal axis to provide gun elevation and depression.

(2) *Saddle assembly.* The saddle assembly is mounted in the gimbal assembly which rotates on the vertical axis to provide gun left and right azimuth.

(3) *Elevation and azimuth powered trunnion assemblies.* Elevation and azimuth movements of the gun are made by the elevation and azimuth powered trunnion assemblies. Each powered trunnion assembly contains a direct-current drive motor which is powered by its respective servo-amplifier. The rotational travel of each powered trunnion assembly is limited by fixed mechanical stops and by adjustable limit switch actuators.

(4) *Ammunition ejection chute.* An ejector chute assembly on the saddle assembly and an ejection hopper on the gimbal assembly form a continuous chute for ejecting spent cartridge cases and misfired cartridges from the turret assembly.

b. *Gun (fig 11-2).* The 40mm gun is an air-cooled, electrically powered, rapid-firing weapon. It is percussion fired and metallic link belt fed. An electric motor drives the gun through the entire operational cycle of feeding, chambering, cocking, locking, firing, unlocking, extracting, and ejecting. The gun has a reciprocating barrel, rotating cam

and cover assembly, feed arm assembly, drive spindle assembly, hammer assembly, and receiver assembly.

(1) When torque is applied to the drive spindle assembly (1), the cam and cover assembly (2) rotates in a clockwise direction. As the cam and cover assembly rotates, the roller (3) of the feed arm assembly follows a path in the rear face of the cam and cover assembly. The feed arm assembly (4) turns on its pivot pin to secure a 40mm cartridge and push it into place in the receiver assembly (5). The gun barrel roller follows the raised track on the cam and cover assembly, moving the barrel back over the cartridge and separating the cartridge link from the link of the next cartridge. The barrel movement also pushes the cocking rod to the rear, cocking the hammer assembly.

(2) When the gun barrel is at its rearmost position, a barrel lock is cammed down to hold the barrel in position. Downward movement of the barrel lock pushes the sear release extension to the rear. The sear release extension actuates the hammer assembly and the hammer strikes the firing pin, firing the cartridge.

(3) After the projectile has left the barrel, the barrel lock is retracted and the barrel is cammed forward. Feeding of the next cartridge pushes the spent cartridge case out of the receiver and into the ejector chute assembly of the turret assembly.

c. *Ammunition Feed System.* The ammunition feed system provides a path for the smooth flow of linked cartridges and assists in pulling the cartridges from the ammunition container and through the chute assemblies. The system consists of the following:

(1) *Ammunition containers.* There are two types of ammunition containers—the *ammunition can and access cover assembly* and the *ammunition box and cover assembly*.

(a) *Ammunition can and access cover assembly (A, fig 11-3).* The rotary drum ammunition can is mounted directly below the main rotor mast. The ammunition is wound around a spool inside the can. The spool rotates within the can as the ammunition is pulled to the gun. A crank handle attached to the top of the spool can be turned manually to assist in loading ammunition.

(b) *Ammunition box and cover assembly (B, fig 11-3).* The ammunition box and cover assembly is located in the center of the helicopter under the passenger seat. It is held in place by toeplates in the deck and webbing assemblies

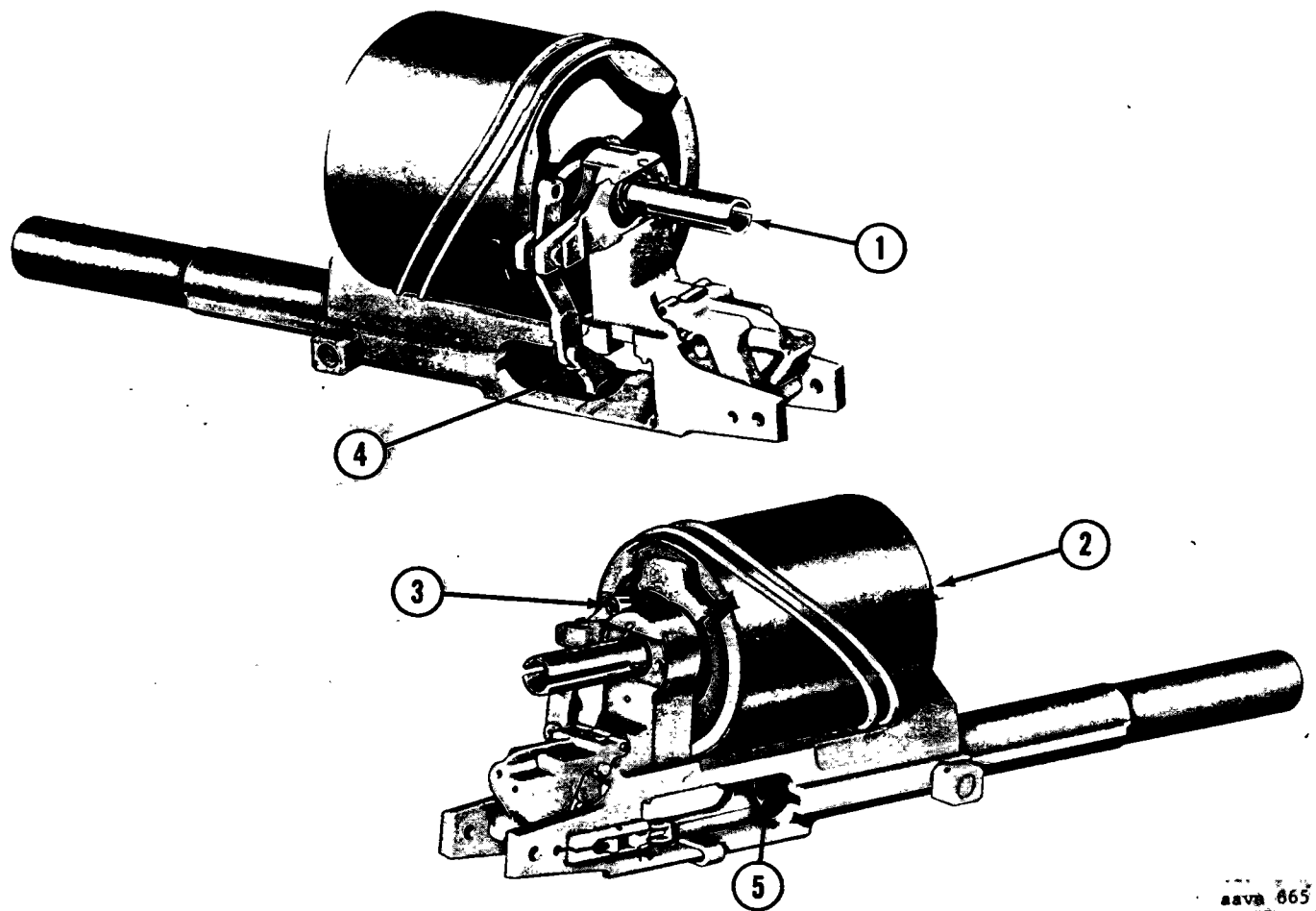


Figure 11-2. Gun.

which are attached by hook snaps to standard cargo tie-down points.

(2) *Ammunition booster assembly (fig 11-4).* The ammunition booster assembly is positioned in the electronic compartment between the rear and forward ammunition chute assemblies. It assists the gun in pulling linked cartridges from the ammunition box. The ammunition booster assembly is powered by a direct-current motor which is energized simultaneously with the gunfiring circuit.

(a) *Loading switch.* Normally, the loading switch (fig 11-4 and 11-5) is not used for loading or unloading procedures. However, the booster motor can be turned on independently for loading or unloading ammunition by pressing the loading switch. This switch can be used to energize the booster motor without moving the MAIN POWER switch on the turret control panel assembly to ON. The helicopter must have electrical power applied and the M5 GUN & BOOST MOTOR circuit breaker pushed in. When the GUN POWER switch on the turret control panel is moved from SAFE to HOT, operating power is

removed from the loading switch as a safety measure.

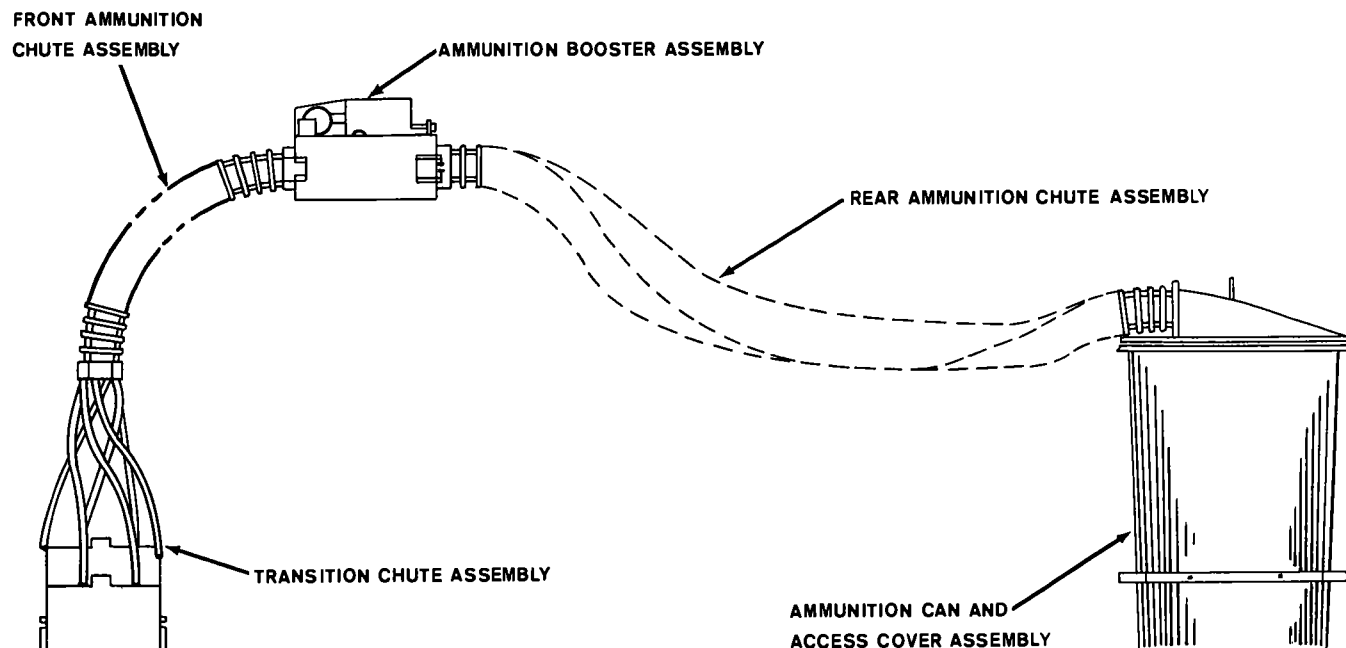
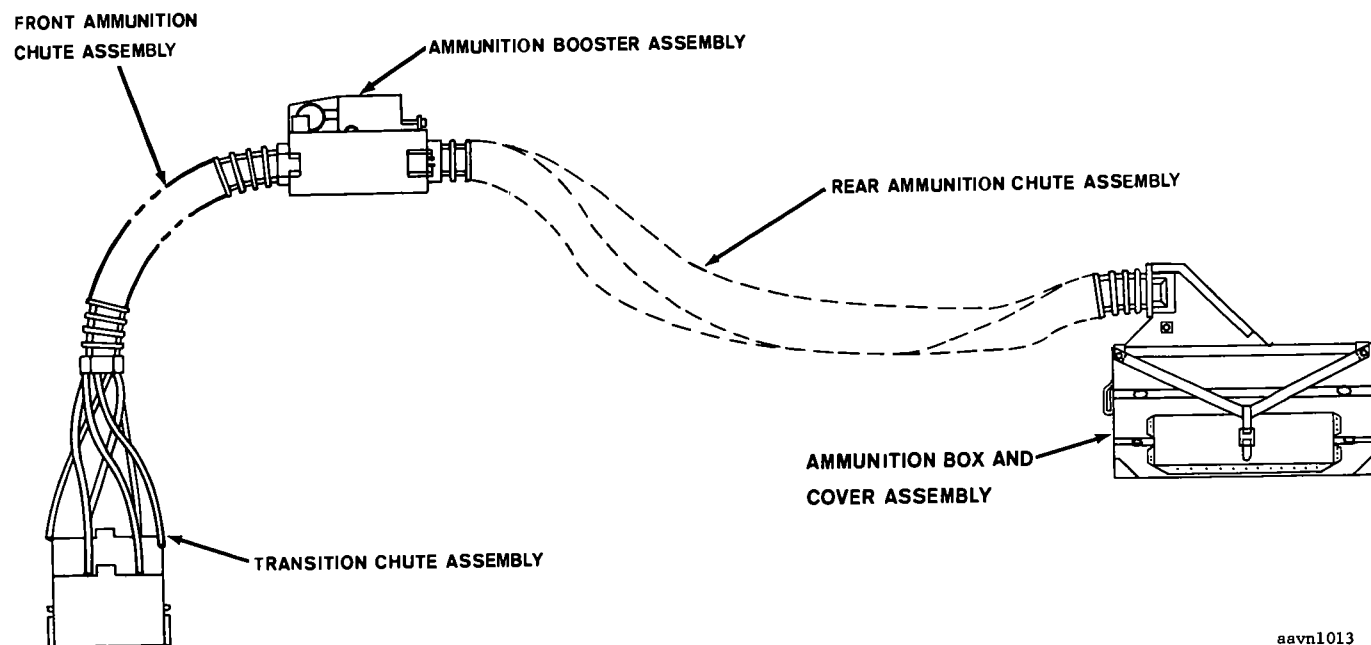
(b) *Feed control switch (fig 11-4).* This switch provides for automatically controlling the speed of the booster motor.

1. Through gears, the booster motor drives a shaft on which two drive sprockets are mounted.

2. The sprockets pull the linked cartridges through the booster. A cover for the sprockets prevents jamming of loose objects and injury to personnel during ammunition loading.

3. A regulator arm mounted on the sprocket shaft supports a lever which rides on the case portion of the linked cartridges as they flow through the ammunition booster assembly. The regulator arm also carries a machine bolt that is adjustable to proper height for contacting the feed control switch.

4. When ammunition demand is low, the linked cartridges crowd together. This crowding forces the lever to ride up on the cartridges. The

**A. ROTARY DRUM FED****B. BOX FED**

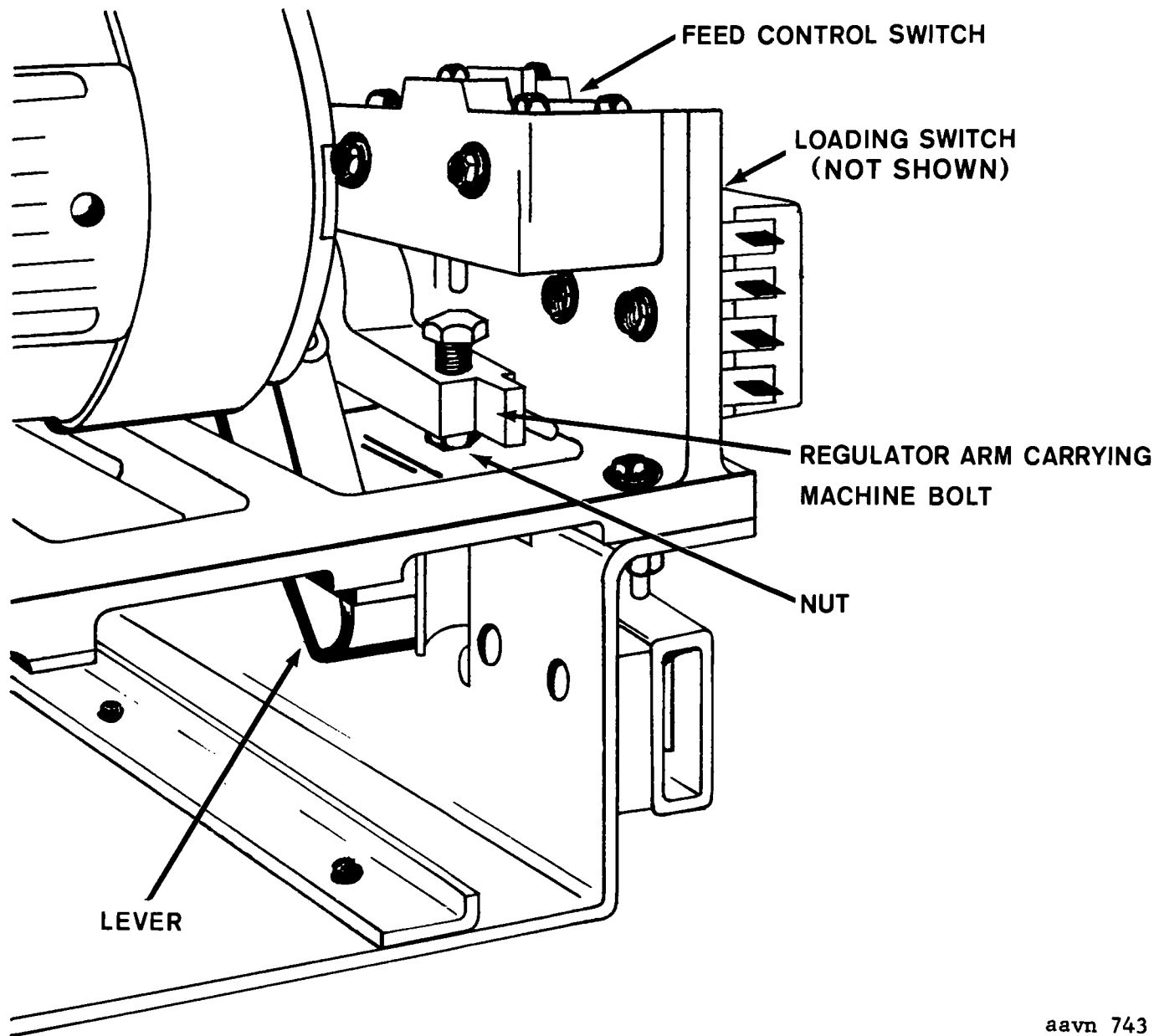
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Figure 11-3. Ammunition feed system.

regulator arm machine bolt then contacts the pin in the bottom of the feed control switch, actuating the switch to reduce motor speed. Reduced motor speed is directly controlled by three resistors mounted to the underside of the sprocket cover.

5. When ammunition demand is high, the linked cartridges are properly spaced and the machine bolt on the arm no longer contacts the switch pin, thus deactuating the feed control switch.

(3) *Front and rear ammunition chute assemblies.* The rear ammunition chute assembly fits into the metal aperture adapter, mounted on the firewall, and runs along the left side of the pedestal console and under the instrument panel to the ammunition booster assembly. The front ammunition chute assembly runs from the ammunition booster assembly to the transition chute assembly in the turret assembly. Altogether, the chuting holds about 75 rounds of ammunition.



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Figure 11-4. Ammunition booster assembly.

(4) *Transition chute assembly.* The transition chute assembly connects the front ammunition chute assembly with the gun. It turns the linked cartridges through 90° so that the cartridges enter the gun with nose pointing forward.

d. *Turret Control Panel Assembly.* The turret control panel assembly (fig 11-6) is mounted next to the gunner in the lower left corner of the pedestal console. The panel is held in place by six turn-lock fasteners. The face of the panel is illuminated and contains the indicators and controls for applying subsystem power, for determining rounds remaining, and for selecting the gun elevation stow position. Electrical connections to the

control panel are made beneath the panel from internal components.

(1) *Controls and indicators.*

(a) *MAIN POWER switch.* Applies operating power to the M5 subsystem.

(b) *OPERATE indicator light.* Lights to indicate that operating power is applied to the subsystem.

(c) *GUN POWER switch.* This two-position switch has a toggle guard for safety. The switch permits firing the gun only when it is moved from the SAFE to the HOT position.

(d) *ARMED indicator light.* Red light in-

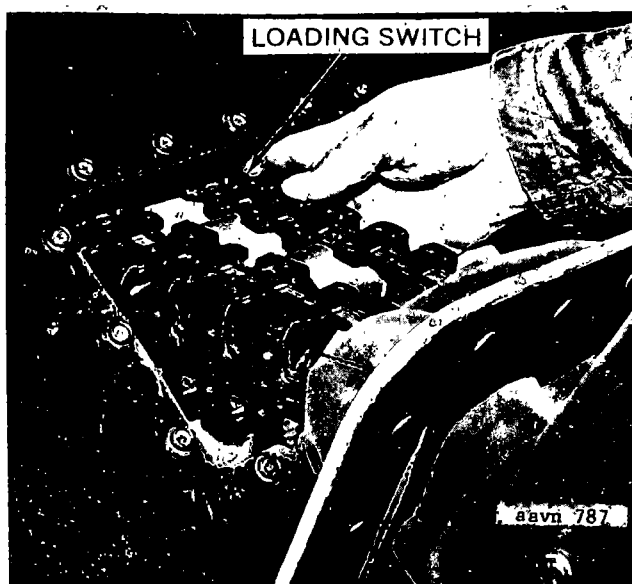


Figure 11-5. Use of loading switch.

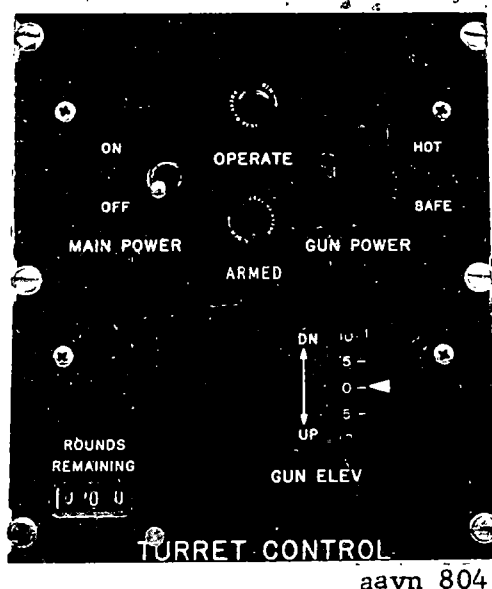


Figure 11-6. Turret control panel assembly.

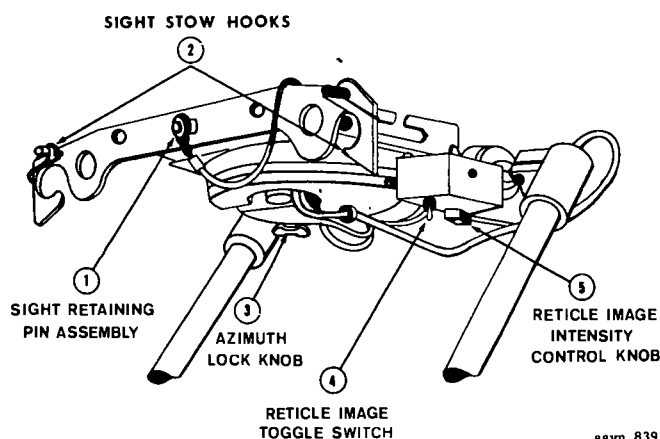


Figure 11-7. Sight mount bracket assembly.

indicates that the subsystem is armed and ready to fire.

(e) *GUN ELEV stow control*. Selects gun elevation or depression desired for stow position. The selector dial associated with the control is graduated in 5° increments from $+15^\circ$ to -35° .

(f) *ROUNDS REMAINING indicator*. Indicates the number of rounds of ammunition remaining to be fired. Pushing the cylindrical reset knob in and turning it clockwise permits the indicator to be set to the number of rounds loaded.

(2) *Internal components*.

(a) Control panel relay.

(b) Manual elevation transmitter synchro assembly (part of the gun stow position elevation control).

(c) A portion of the components and circuitry for dynamic braking (para 11-12) of the gun motor.

(d) Wiring to connect the control panel assembly with other components of the subsystem.

(e) A portion of the lead compensation system.

e. *Sight Mount Bracket Assembly*. The sight mount bracket assembly (fig 11-7) is secured to a plate in an overhead position on the left (gunner's) side of the cabin of the helicopter. It mounts the hand control sight assembly. As the sight mount group is slid into the bracket assembly, an electrical connector mates with a receptacle in the bracket. Proper mating of the connector and receptacle is insured by an index pin on each side of the receptacle.

(1) *Sight retaining pin assembly* ((1), fig 11-7). The sight retaining pin assembly is a quick-release type pin on a lanyard, secured to the left side of the sight mount bracket assembly. In use, the sight retaining pin assembly is passed through holes in the sight mount bracket assembly and the sight assembly to hold the sight assembly securely in place.

(2) *Sight stow hooks* ((2), fig 11-7). Two sight stow hooks are provided, one at each end of the sight mount bracket. The hooks are spring loaded to be retained in the closed position. When the sight assembly is pushed into contact with the stow hooks, the stow hooks are cammed outward until the sight assembly reaches its final stow position. The stow hooks then pivot inward and secure the stowed sight assembly.

(3) *Azimuth lock knob* ((3), fig 11-7). This knob can be turned to lock the azimuth frame assembly in one position.

(4) *Reticle image toggle switch* ((4), fig 11-7). Moving this three-position toggle switch to either side of the center position lights the lamp that illuminates the sight reticle.

(5) *Reticle image intensity control knob* ((5), fig 11-7). This knob is attached to a variable resistor in the bracket with the reticle image toggle switch. When the toggle switch is turned on, movement of the control knob brightens or dims the intensity of the reticle image.

f. Hand Control Sight Assembly. The hand control sight assembly permits the gunner to remotely aim and fire the gun. Throughout the field of fire, the sight assembly maintains a relationship between the gunner's line of sight and the line of fire of the gun. Sight movement must be steady and smooth to maintain coordination between sight and turret assembly. The hand control sight assembly consists of a—

(1) *Mount group.* The mount group slides into the sight mount bracket assembly and is secured by the sight retaining pin assembly (e above). The mount group contains an azimuth frame assembly attached to the mount assembly. The azimuth frame assembly rotates on ball bearings within azimuth limits set by stops. Setscrews on the stops provide for azimuth travel adjustment. Synchro and gear assemblies are mounted on the azimuth frame assembly and the mount assembly. When the sight assembly is energized and operated, movement in azimuth and/or elevation generates electrical impulses that are transmitted by the synchro and gear assemblies to the powered trunnion assemblies in the turret assembly. The azimuth frame assembly supports the suspension system through a tube mounted along the rear end of the frame. A spring mounted around the tube allows the sight to "float" in a neutral position in front of the gunner.

(2) *Suspension system.* The suspension system consists of spring-tensioned telescoping tube assemblies that pivot on the azimuth frame assembly. When released, the tubes tend to return to the retracted position. The sight is mounted on the ends of the tube assemblies.

(3) *Sight.* The sight consists of the—

(a) *Right- and left-hand support assemblies.* The support assemblies are attached to the ends of the tubes of the suspension system. The right-hand support assembly provides a bearing mount for the shaft that connects the guide with the controller grip assembly. The left-hand support assembly is also bearing mounted; this permits the guide to be easily rotated through the movement of the controller grip assembly. The

left-hand support assembly contains the reticle housing assembly, reticle lamp, elevation transmitter synchro assembly, and a sight reticle range scale selector switch. The selector switch is located on the rear of the left-hand support assembly. This switch permits the gunner to select either the high or low range scale on the reticle by setting the switch to either the H or L position.

(b) *Guide.* The guide contains a glass reflector and spherical mirror housing assembly. It is open on both sides of the reflector to provide the gunner with a clear view of the target area. A sun filter can be lowered (B, fig 11-8) to permit the gunner to clearly see the target on bright sunny days. The reflector is mounted at an angle of 45° to the gunner's line of sight and slightly to the right of the centerline of the guide. The reflected collimated reticle image (fig 11-9) is displayed on the reflector. The gun cannot be fired when the reticle is flashing (also, the ARMED indicator light will not be illuminated on the turret control panel). A flashing reticle image indicates one (or more) of the following conditions—

1. The turret is in an azimuth or elevation limit position.
2. The position of the sight and turret is out of synchronization.
3. There is an electrical malfunction in the subsystem.
4. The turret control switch is not depressed.

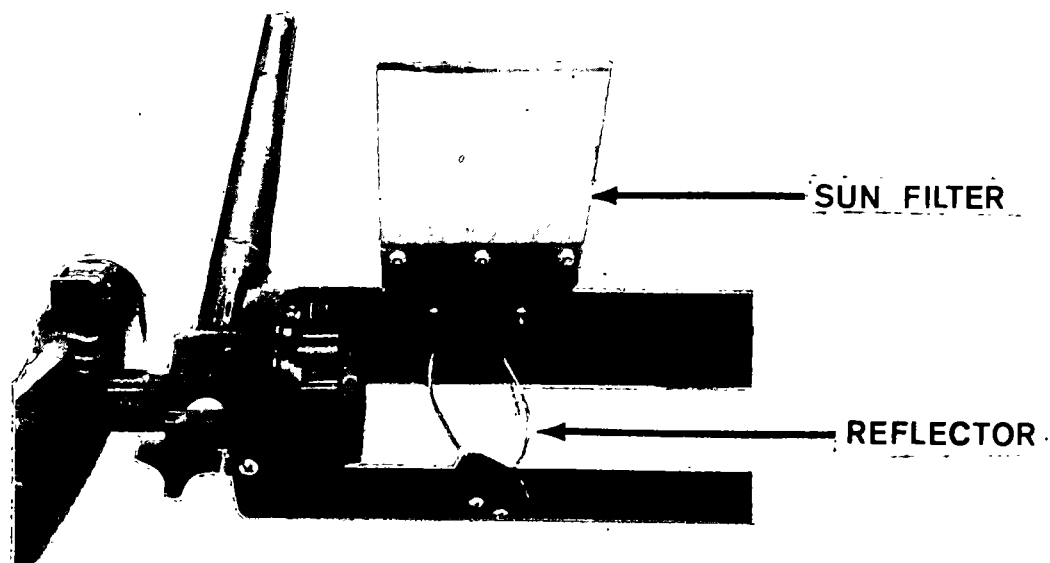
(c) *Controller grip assembly.* The controller grip assembly contains the turret control switch, the gun trigger switch, and the elevation lock knob (B, fig 11-8).

1. *Turret control switch.* When depressed and held, this switch activates circuits which turn the turret assembly in azimuth and elevation, according to the electrical signals generated by movement of the sight in azimuth and elevation. Depressing this switch also permits firing the gun by depressing the gun trigger switch. Releasing the turret control switch returns the turret and gun to the stow position.

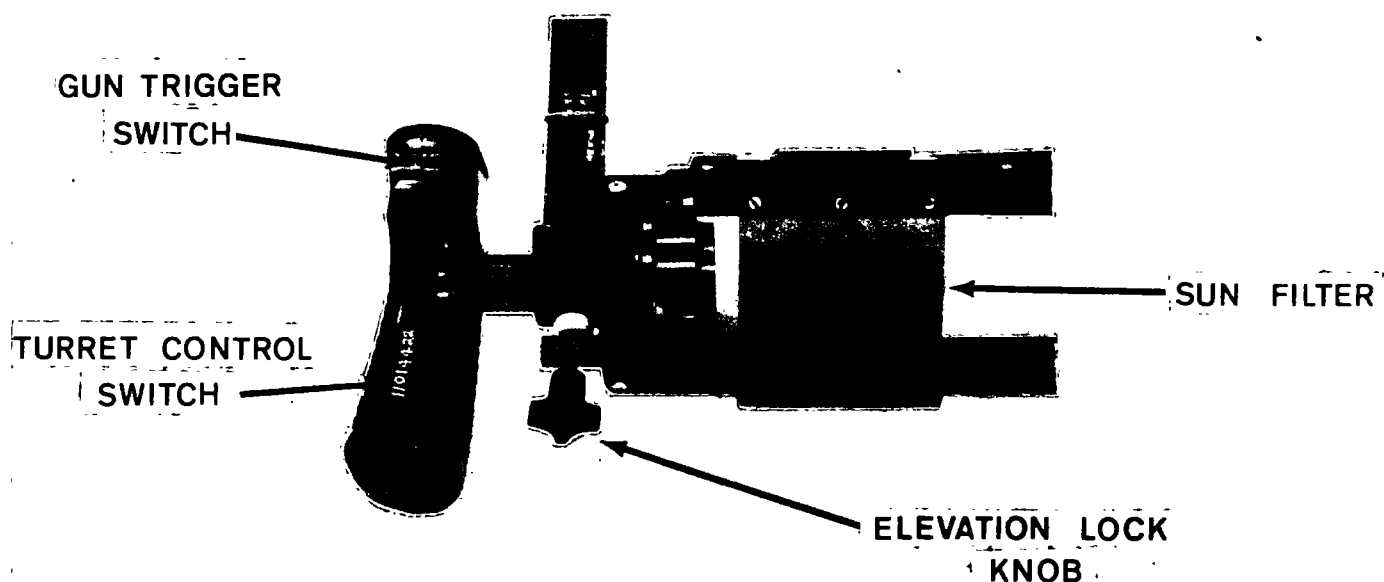
2. *Gun trigger switch.* When the turret control switch and the gun trigger switch are both held depressed, the gun trigger switch closes the gun drive motor circuits and ammunition booster assembly circuits.

3. *Elevation lock knob.* This knob can be turned to lock the sight assembly guide in one position.

g. Firing Switches. When the turret control switch is released and the turret is in the stow position, either the gunner or pilot can fire the



A. SUN FILTER UP



B. SUN FILTER DOWN

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Figure 11-8. Sight guide and controller grip assembly.

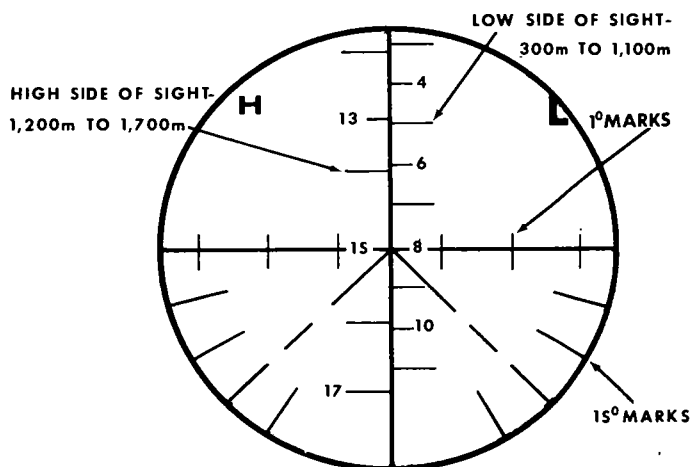


Figure 11-9. Sight reticle image.

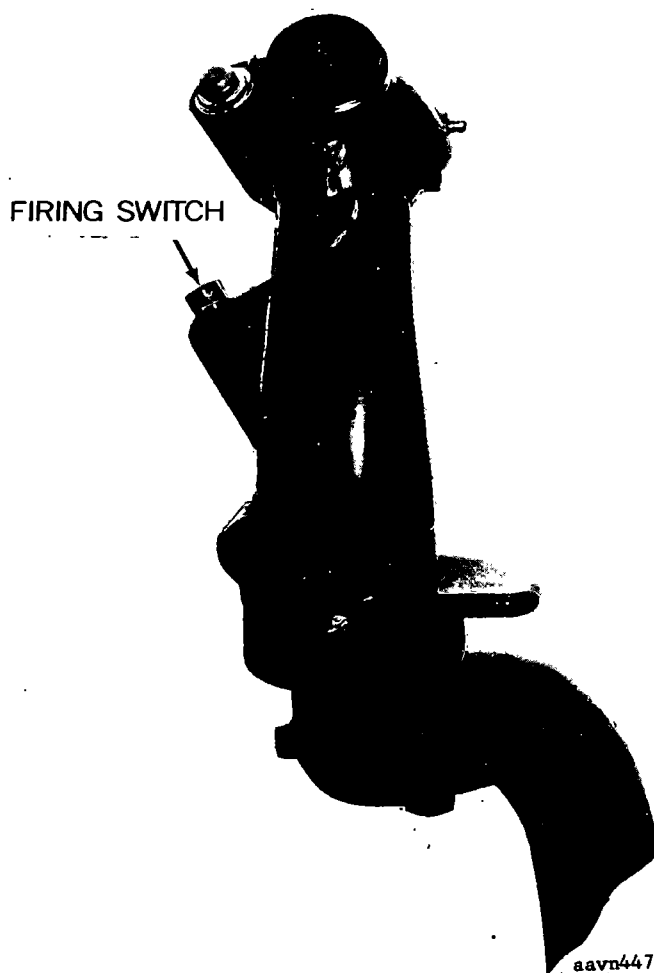


Figure 11-10. Firing switch.

gun by depressing the firing switch (fig 11-10) on either cyclic control stick.

h. Servo-Amplifier Junction Box Assembly. The servo-amplifier junction box assembly contains two servo-amplifier module assemblies, a control

module, relay switching and control circuits for the subsystem, components of the automatic lead compensation device, and a switch to remove the compensation when desired for testing or instructional purposes. The servo-amplifier junction box assembly is located in the baggage compartment of the helicopter. Holes in the junction box assembly mounting brackets fit over studs on two channel beams in the helicopter. The cover assembly is secured by two tabs on one end and two turn-lock fasteners at the other end.

(1) Cooling air circulation is supplied by an exhaust-type blower mounted on one side of the box. Test jacks, designated TP1 through TP18, are mounted on both sides of the blower to permit electrical troubleshooting tests without having to remove the cover assembly.

(2) Five externally-mounted receptacles provide for subsystem electrical interconnection.

(3) The two amplifier module assemblies are interchangeable and are secured in the junction box by a module retainer assembly.

(4) The flashing reticle (f(3)(b) above) circuit is also contained in the junction box.

11-5. Preflight Checks

Warning: Do not attempt to perform preflight checks with high explosive or practice ammunition loaded in the transition feed chute assembly or gun. If this ammunition is present, unload in accordance with paragraph 11-7.

a. Connect auxiliary power unit to the helicopter.

Caution: If auxiliary power is used to operate the subsystem, only battery-type power units will be used.

b. Push in the following circuit breakers and turn the indicated switches to the positions named:

(1) AC circuit breaker panel (fig 11-11).

(a) M-5 ARM (115 volts AC, synchronization, magnetic, amplifier, and stow).

(b) M-5 ARM (28 volts AC bias power).

(2) DC circuit breaker panel (fig 11-12).

(a) INVTR CONT.

(b) MAIN INVTR PWR.

(c) SPARE INVTR PWR.

(d) VOLT METER-NON-ESS-BUS.

(e) M5 GUN & BOOST MOTOR (35 amp gun drive and booster drive power).

(f) M5 AZ (7 amp, azimuth drive power).

(g) M5 EL (7 amp, elevation drive power).



Figure 11-11. Pedestal (pilot's side)
AC circuit breaker panel.

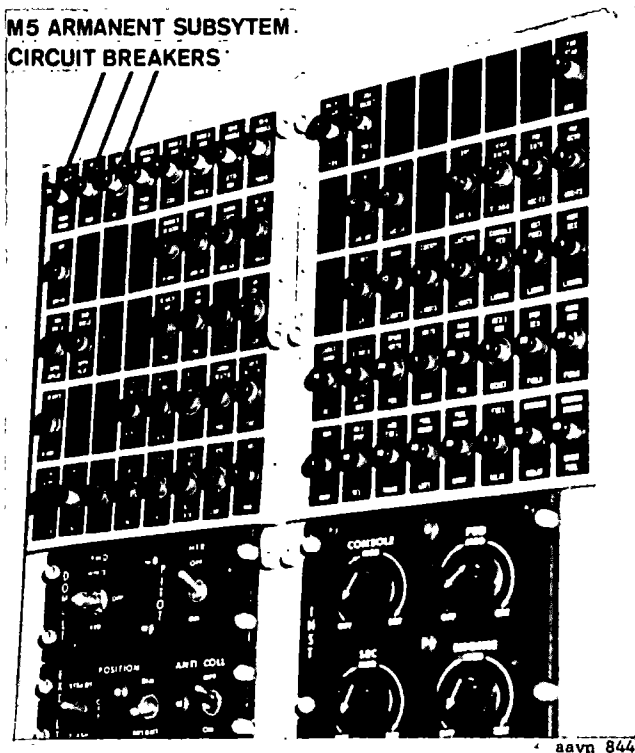


Figure 11-12. Overhead DC circuit breaker panel.

(3) *Overhead console switches.*

- (a) INVTR switch to SPARE ON.
- (b) PHASE selector switch to AB (AC voltmeter indicates 115 volts).
- (c) NON-ESS-BUS to manual ON.
- (d) If no external power is used, turn BATT switch to ON.

c. On turret control panel (fig 11-6), set MAIN POWER switch to ON; the turret will move to the stow position (if its position has been moved from the stow position) and the OPERATE indicator will light.

d. On turret control panel (fig 11-6), move GUN ELEV stow control throughout its full travel. The turret should follow the movement of the control in elevation.

e. Release sight from stow position but do not depress turret control switch (B, fig 11-8). A flashing reticle image should be visible on the reflector.

f. Depress turret control switch. Reticle image should stop flashing and remain steady. The turret should assume the position of the sight.

g. Release turret control switch (turret reverts to 0° azimuth and elevation stow position). Set GUN POWER switch (fig 11-6) on turret control panel assembly to HOT (ARMED indicator light should illuminate).

h. With turret control switch (B, fig 11-8) depressed, move sight in azimuth to both the right and left limits. Reticle should flash when turret limits are reached.

i. Using dummy rounds to avoid breaking the firing pin, depress turret control switch and gun trigger switch (B, fig 11-8). The gun and booster should cycle while the gun trigger switch is depressed. The gun should continue to cycle for two or three rounds before stopping. Release turret control switch and gun trigger switch.

j. Using dummy rounds, press firing switch (fig 11-10) on each cyclic control stick. The gun and booster should cycle while each firing switch is pressed and stop after release of the trigger when two or three rounds have cycled.

k. Set GUN POWER switch (fig 11-6) to SAFE (ARMED indicator light should go out) and place sight in the stow position.

l. On turret control panel, set MAIN POWER switch to OFF; OPERATE indicator light should go out.

m. Pull out circuit breakers listed in b above,

and disconnect auxiliary power unit from the helicopter.

n. Set ROUNDS REMAINING (fig 11-6) indicator to 150/300.

11-6. Loading Ammunition

Warning: Observe ammunition handling safety precautions. See TM 9-1010-207-12, 9-1300-200, and 9-1300-206 for details on handling ammunition.

a. Rotary Drum Fed Ammunition System.

(1) Disconnect aft chute from aperture adapter.

(2) Obtain ammunition complement consisting of six 50-round belts. Arrange and connect these belts to make one belt of 220 rounds and one belt of 80 rounds. If safety conditions warrant, attach one linked aluminum dummy round containing a rubber firing pin insert to connector end of last 50-round belt. This dummy round must be the last round of the 300 rounds to feed.

Caution: Examine rounds for correct linking and position (fig 11-13 and 11-14).

(3) Grasp end of belt containing dummy

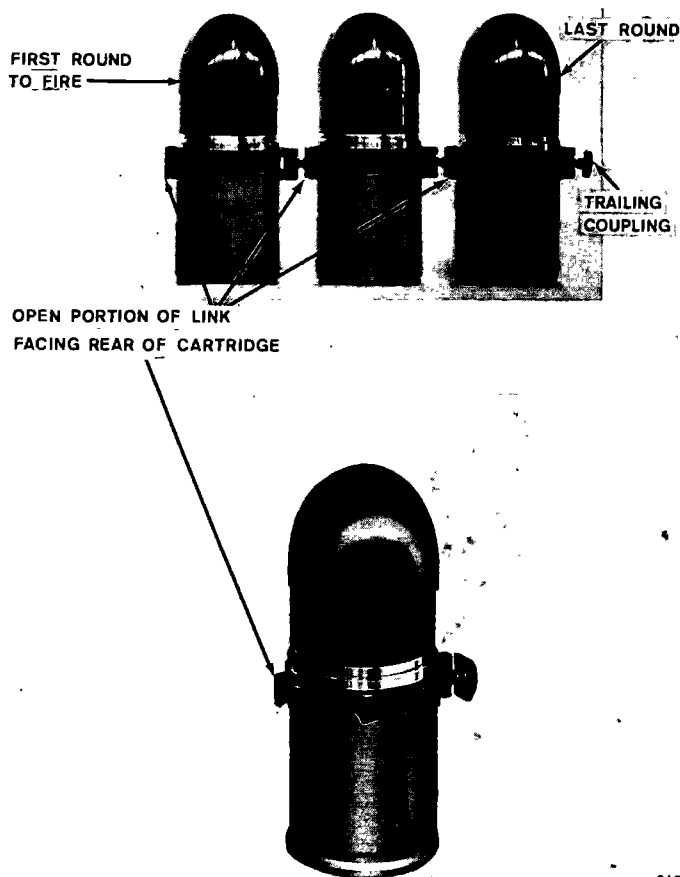


Figure 11-13. Examples of correct linking.

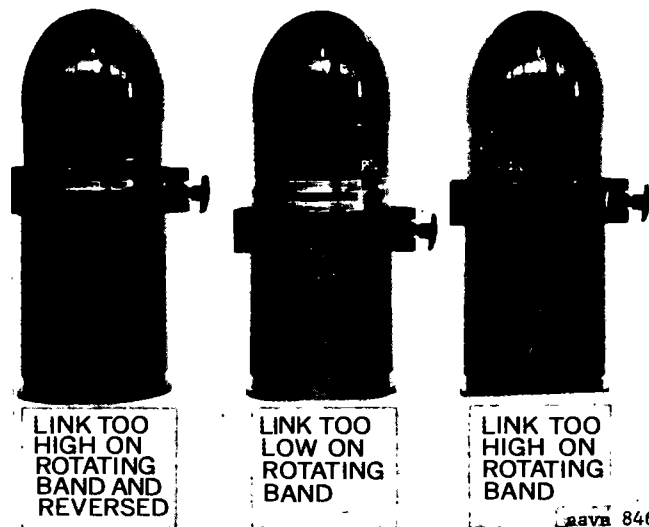


Figure 11-14. Examples of incorrect linking.

round and place the dummy round end in the aperture opening on the firewall so that the nose of the round is pointing to the right of the helicopter. Feed the ammunition into the can until the last round of the belt can be engaged in the spool. Then rotate the spool by turning the manual crank on top of the ammunition can. This pulls the remainder of the 220-round belt into the can, winding it around the spool.

(4) With approximately three rounds trailing from the aperture in the firewall, replace the access cover.

b. Box Fed Ammunition System.

(1) Remove access cover by releasing the hook snaps and removing the rear chute assembly.

(2) Obtain ammunition complement consisting of three 50-round belts. Arrange and connect these belts to make two belts of 75 rounds.

(3) Feed one 75-round belt into the box so that the nose of the round is pointing to the right of the helicopter.

(4) With approximately three rounds trailing, replace assembly cover.

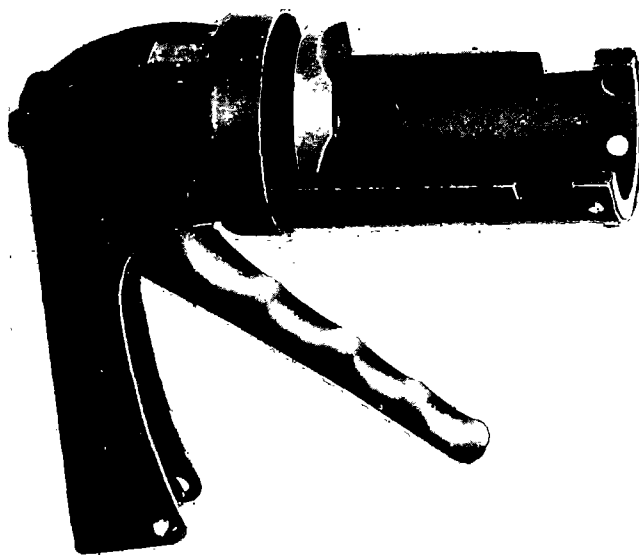
Note. Paragraphs c through l below apply to both of the above ammunition feed systems.

c. Remove top enclosure by releasing the strap and sliding the enclosure 1 inch to the right. Then slide enclosure, with boot attached, up toward center of forward flexible chute.

d. Disconnect forward flexible chuting from the transition chute assembly.

e. Insert hook end of loading cable through opening in forward chute and continue inserting cable until the hook emerges from the rear of the aft chute.

Note. Open portion of flexible chuting must face up.



HAND LINKER-DELINKER
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(aavn 847)

Figure 11-15. Hand linker-delinker.

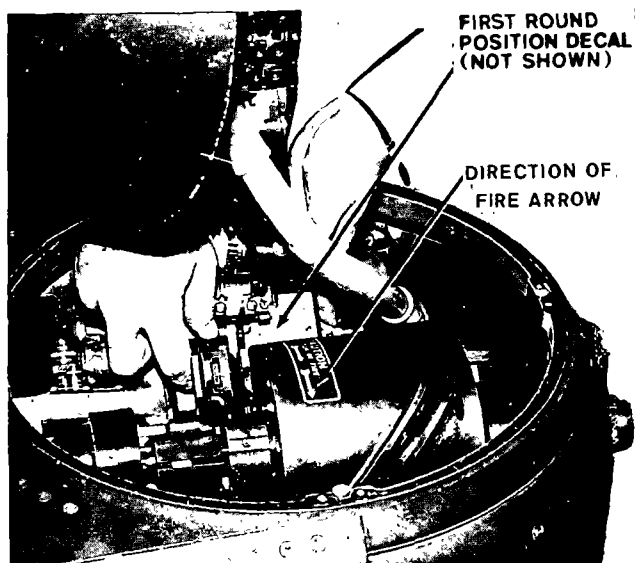


Figure 11-16. Positioning the first round.

f. Attach hook to end of remaining belt of ammunition so that the nose of the rounds is pointing to the right of the helicopter with the link coupling always on the trailing side of the cartridge.

Caution: Examine rounds for correct linking and position (fig 11-13 and 11-14).

g. Pull ammunition through chutes and booster until five rounds are past the forward end of the front flexible chute. Remove hook from link.

h. Join the two belts of ammunition by using hand linker tool (fig 11-15).

i. Connect end of aft chute to the aperture adapter, insuring that the latches are fully engaged on catches.

j. Insert the five rounds, hanging from the front ammunition chute, into the transition chute assembly. Press the first round past the belt-holding pawl on top of the transition chute assembly. Then continue pressing the first round until it is in line with the decal on the transition chute assembly (hidden in fig 11-16).

Warning: Do not push the first round into the gun receiver.

k. Place top enclosure on turret and secure.

l. Depress reset knob on turret control panel and rotate until the rounds remaining counter is set for the number of rounds loaded.

11-7. Clearing Gun and Unloading Ammunition

Warning: Insure that the area forward of weapon is clear of personnel and equipment. Before performing clearing procedures, determine that no unfired live cartridges are in the gun receiver assembly. Do not stand in front of the gun. Observe ammunition handling safety precautions (TM 9-1010-207-12).

a. Before proceeding, make certain the procedures in paragraph 11-9d(3) below have been accomplished.

b. Remove the top enclosure assembly from the turret and slide it and the ammunition chute external boot up the front ammunition chute.

c. Check the position of the gun barrel.

(1) If the barrel is forward, inspect the gun receiver assembly to determine whether the cartridge has been fired.

(a) If the cartridge has been fired, push the spent case out of the receiver assembly by hand.

(b) If a cartridge is in the receiver, has not been fired, and the link has not been stripped from the belt—

1. Carefully rotate the cam and cover assembly in the direction of the arrow on the caution instruction plate (fig 11-16) just enough to uncouple the link.

Caution: Any further rotation of gun cam will start cocking action in the hammer assembly.

2. Rotate the cam and cover assembly ((2), fig 11-2) in the reverse direction until the barrel is fully forward. Manually depress the car-

tridge stop while pushing the round from the receiver.

Caution: Catch the unfired cartridge as it drops from the ejection chute below the turret.

(c) If the link has been stripped from the belt of the cartridge in the receiver assembly, push the cartridge from the gun, being careful to catch it (2 above).

(2) If the barrel is to the rear and the cartridge has been stripped from its link, rotate the cam and cover assembly in the opposite direction of that shown by the arrow on the caution instruction plate to determine whether or not the cartridge has been fired. Remove the spent case or the unfired cartridge, as applicable.

Note. If the complete complement of cartridges has been fired, the gun barrel may stop over the plug and link assembly. Proceed as in (2) above and push the plug and link assembly out of the receiver assembly by hand.

d. Remove the exit and fitting of the front ammunition chute assembly from the transition chute assembly (fig 11-17).

e. Depress the belt holding pawl and remove the linked cartridges from the transition chute assembly (fig 11-18).

f. If the ammunition booster assembly is to be used to unload the subsystem—

(1) Remove the ammunition chute external boot assembly to gain access to the ammunition booster assembly.

(2) Energize the helicopter DC power control panel by moving the BAT switch to ON.

g. Withdraw the remaining linked cartridges from the free end of the front ammunition chute

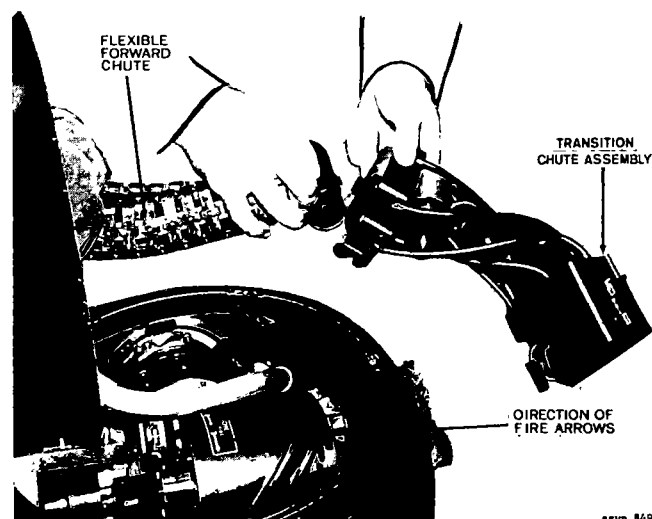


Figure 11-17. Disconnecting transition chute assembly from flexible forward chute.

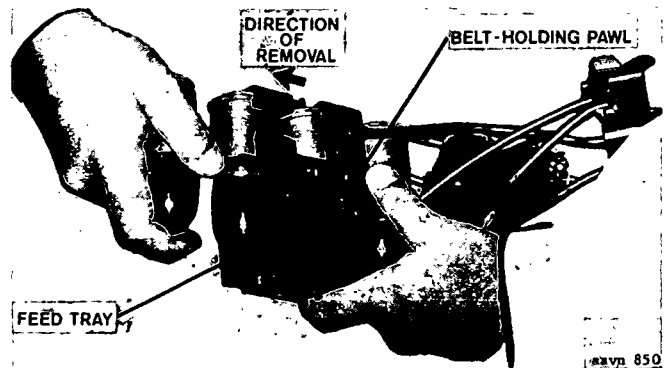


Figure 11-18. Removal of ammunition from transition chute assembly.

assembly manually or by pressing the ammunition booster assembly loading switch.

Caution: Avoid dropping unfired linked cartridges. Do not allow cartridge primers to strike any objects.

h. Store all unfired linked cartridges in accordance with TM 9-1010-207-12 and 9-1300-206.

i. Install the exit end fitting of the front ammunition chute assembly on the transition chute assembly, then install the ammunition chute external boot assembly.

j. If the ammunition booster assembly was used to unload the subsystem, deenergize the helicopter DC power control panel by moving the BAT switch to OFF.

11-8. Harmonization (Boresight Procedure)

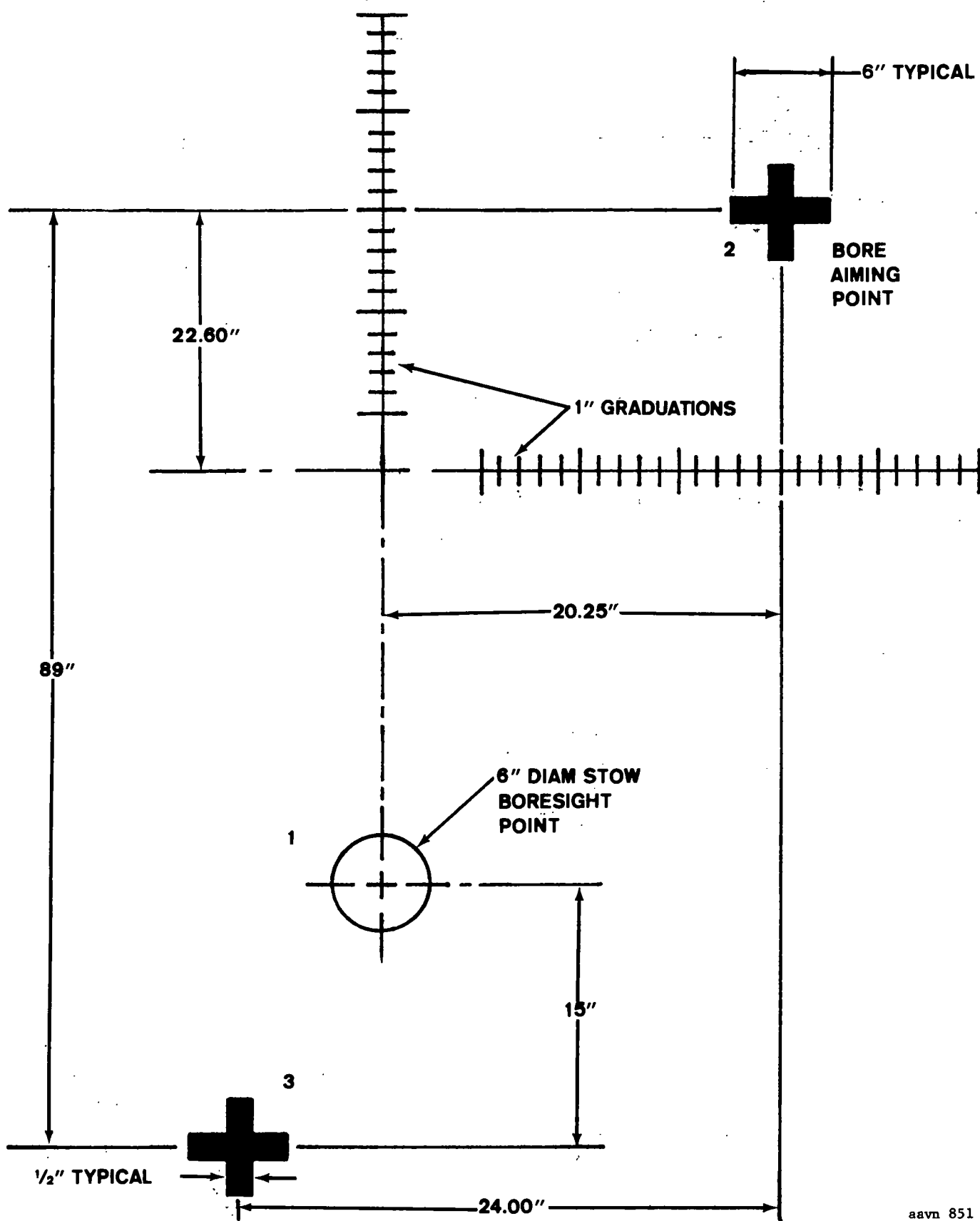
Two men are required to boresight the armament subsystem M5. The subsystem should be boresighted as necessary to assure accuracy in firing. Use the dimensions shown in figure 11-19 to construct the boresighting target shown in figure 11-20.

Warning: Do not attempt to boresight a subsystem when the gun is still hot from firing. Allow the gun barrel to cool before proceeding. Then do not stand in front of gun until transition chute assembly and gun receiver assembly have been inspected for ammunition (c below).

a. Place the helicopter on level ground. Approximately 100 feet of level ground should be in front of the turret assembly.

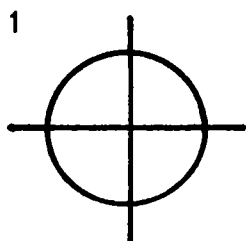
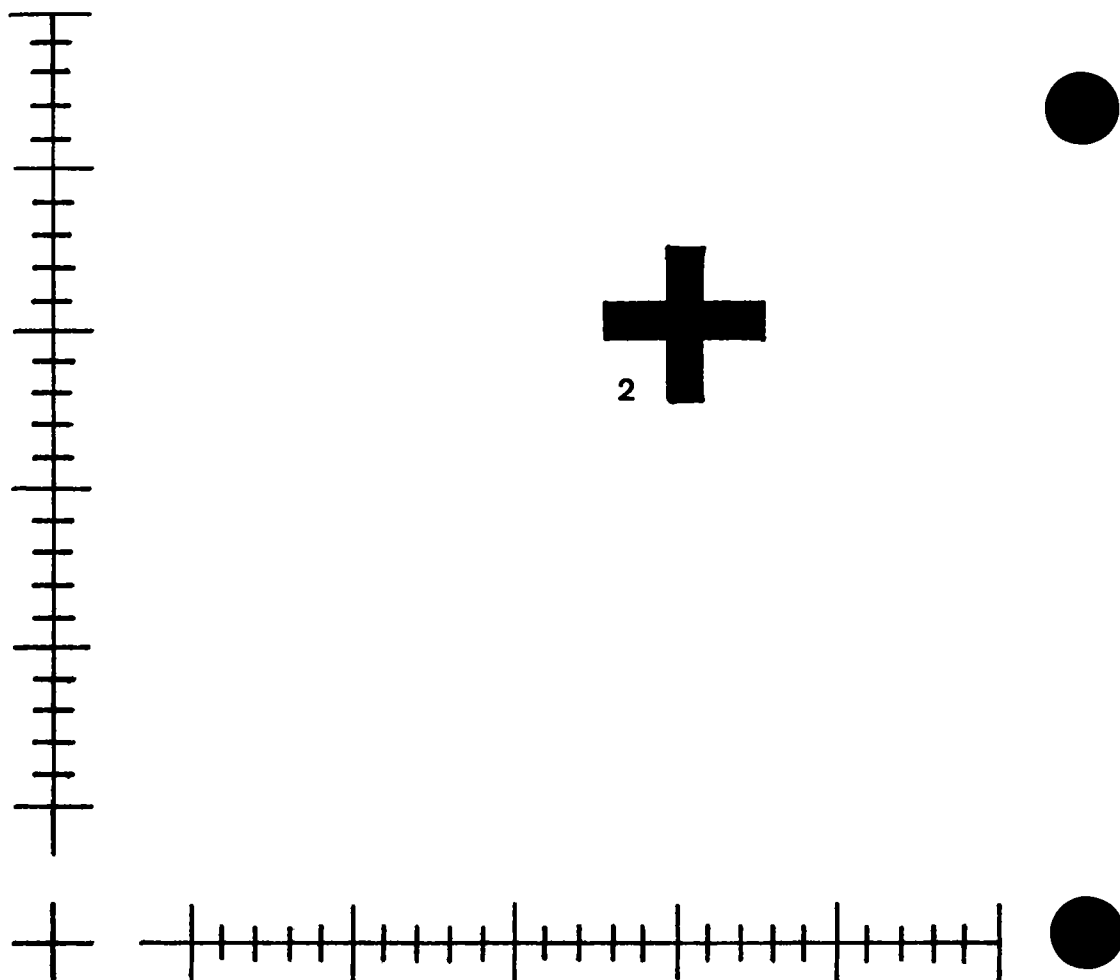
b. Remove the top and forward enclosure assemblies from the turret assembly.

c. Inspect the gun receiver and transition chute assemblies for the presence of high explosive or practice ammunition. If either type is found, unload in accordance with paragraph 11-7.



aavn 851

Figure 11-19. Diagram for 700-meter boresighting target.



aavn 852

Figure 11-20. 700-meter boresighting target.

d. Manually rotate the cam and cover assembly of the gun until the gun barrel is in its rearmost position.

e. One operator should sit in the gunner's seat in the helicopter and turn the selector dial of the stow position elevation control on the turret control panel assembly until the indicator dial is at 0°.

Caution: See that the GUN POWER toggle switch on the turret control panel assembly is on SAFE, with the toggle guard in the lowered position.

f. Push in the following circuit breakers and turn the indicated switches to the positions named:

(1) AC circuit breaker panel.

(a) M-5 ARM (115 volts AC, synchronization, magnetic, amplifier, and stow).

(b) M-5 ARM (28 volts AC bias power).

(2) DC circuit breaker panel.

(a) INVTR CONT.

(b) MAIN INVTR PWR.

(c) SPARE INVTR PWR.

(d) VOLT METER-NON-ESS-BUS.

(e) M5 GUN & BOOST MOTOR (35 amp gun drive and booster drive power).

(f) M5 AZ (7 amp, azimuth drive power).

(g) M5 EL (7 amp, elevation drive power).

(3) Overhead console switches.

(a) INVTR switch to SPARE ON.

(b) PHASE selector switch to AB (AC voltmeter indicates 115 volts).

(4) Turret control panel assembly. Set MAIN POWER toggle switch to ON.

g. The OPERATE indicator light on the turret control panel assembly should now light.

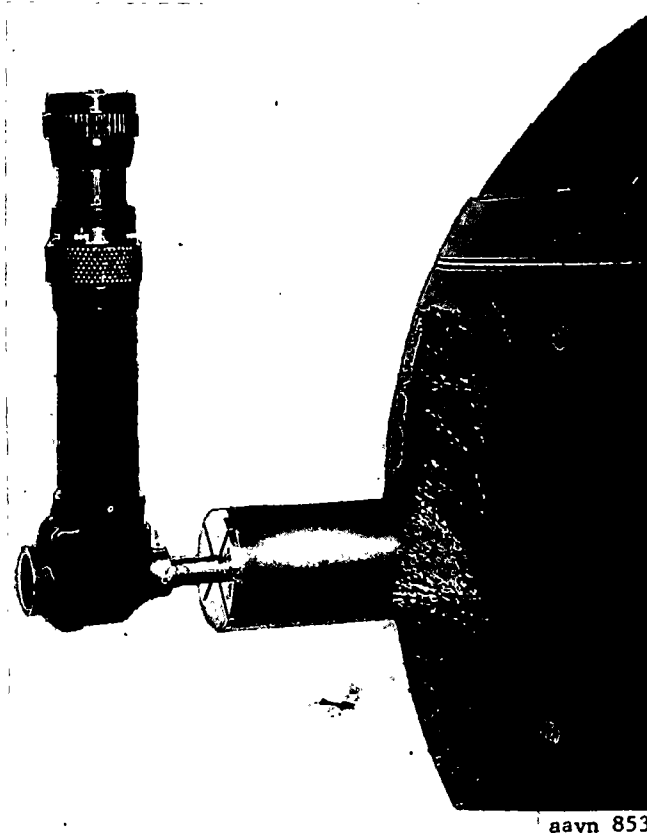
h. See that the helicopter engine is off.

i. Insert the 40mm boresight adapter from the 40mm boresighting kit into the muzzle of the gun barrel until the adapter flange is up against the end of the barrel.

j. Insert the 40mm boresight telescope firmly in the adapter with the viewing piece vertical (fig 11-21).

k. Set the boresighting target (fig 11-20) 1,000 inches in front of the end of the gun barrel. Maneuver the target so that position 1 on the target is aligned with the crosshairs of the viewing piece of the 40mm boresight telescope.

l. In the helicopter, release the sight assembly



aavn 853

Figure 11-21. 40mm boresight telescope in position.

from the stow hooks on the sight mount bracket assembly. Depress and hold the turret control switch.

m. Move the sight assembly until the 700-meter rangemark coincides with the crossed lines at position 3 on the target.

n. At the turret assembly, look through the boresight telescope and note the location of the crosshairs with relation to the crossed lines at position 2 on the target. If the telescope crosshairs do not coincide with the crossed lines, determine the amount of displacement of the crosshairs in elevation and azimuth by counting the 1-mil graduations on the target. Announce the displacement to the operator using the sight assembly.

Note. The elevation and azimuth adjusting screws on the sight assembly have raised portions on the heads for indicator points. The edges of the screw access holes are marked off with eight lines. When an adjusting screw is turned so that the indicator point moves from one line to another, the screw has moved the reticle image 1 mil at 700 meters, or 1 mil on the boresighting target. Turning the azimuth adjusting screw clockwise moves the reticle image to the right.

o. In the helicopter, release the turret control switch. Turn the azimuth and elevation adjusting screws clockwise or counterclockwise, according

to the placement announced by the operator using the boresight telescope.

p. Again depress and hold the turret control switch and repeat steps *m*, *n*, and *o* above until crosshairs of the boresight telescope are alined with position 2 on the target when the reticle 700-meter rangemark is held on position 3.

q. Push the sight assembly up to the bracket assembly until the stow hooks grasp the suspension system.

r. Turn off the switches (*f*(3) and (4) above) and pull out the circuit breakers listed in *f*(1) and (2) above.

s. Remove the boresight telescope and boresight adapter from the gun barrel and remove and store the boresighting target.

Note. If the subsystem is to be loaded with ammunition, follow procedures indicated in paragraphs 11-5 and 11-6 at this time.

t. Install the top and forward turret enclosure assemblies in the turret assembly.

Note. If the subsystem cannot be boresighted using the above procedures (the sight reaches the stops), minor adjustment of the mounting braces will normally bring the weapon into limits.

11-9. Gunner's Checklist for Firing

a. Exterior Inspection.

- (1) Turret assembly—SECURED.
- (2) Top enclosure assembly—FASTENED.
- (3) Forward enclosure assembly—FASTENED.
- (4) Boot assembly—FASTENED.

b. On Entering the Helicopter.

- (1) GUN POWER toggle switch guard—DOWN.
- (2) MAIN POWER toggle switch—OFF.
- (3) Armament AC and DC circuit breakers—IN.
- (4) Sight assembly—STOWED.
- (5) Ammunition—LOADED.
- (6) ROUNDS REMAINING indicator set on number of rounds loaded.

c. In Flight.

- (1) *Firing using hand control sight assembly.*
 - (a) MAIN POWER toggle switch—ON.
 - (b) GUN POWER toggle switch—HOT.
 - (c) ROUNDS REMAINING indicator—CHECK.

(d) Hand control sight assembly—released from STOWED POSITION.

(e) Turret control switch—DEPRESSED.

(f) Gun trigger switch—PRESS TO FIRE.

(2) *Stow firing position.*

(a) MAIN POWER toggle switch—ON.

(b) GUN POWER toggle switch—HOT.

(c) ROUNDS REMAINING indicator—CHECK.

(d) Firing switch on either cyclic control stick—PRESS TO FIRE.

d. After Firing.

(1) *Using hand control sight assembly.*

(a) Hand control sight assembly—STOW.

(b) GUN POWER toggle switch—SAFE.

(c) MAIN POWER toggle switch—OFF.

(2) *Stow firing position.*

(a) GUN POWER toggle switch—SAFE.

(b) MAIN POWER toggle switch—OFF.

(3) *Before leaving helicopter.*

(a) GUN POWER toggle switch—SAFE.

(b) MAIN POWER toggle switch—OFF.

(c) AC and DC ARM circuit breakers—OUT.

(d) Hand control sight assembly—STOWED.

11-10. Turning on Subsystem Electrical Power

After all preflight checks are made (para 11-5), electrical power for the subsystem is obtained by—

a. Pushing in the Five M5 Subsystem Circuit Breakers.

- (1) M-5 ARM (two circuit breakers).
- (2) M5 GUN & BOOST MOTOR.
- (3) M5 AZ.
- (4) M5 EL.

b. Setting the following switches:

- (1) MAIN POWER switch—ON.
- (2) GUN POWER switch—HOT.

Note. The subsystem will not operate if a positional error of more than 35 mils exists between the turret and the input signals. Do not have the turret at either of the azimuth or elevation limits.

11-11. Flexible and Stow Firing Positions

When the subsystem is energized (para 11-10), the turret will automatically be driven to the stow position and the OPERATE indicator will light. As soon as the GUN POWER switch is placed in

the HOT position and the ARMED indicator light illuminates, the subsystem is ready for operation in either the flexible or stow position. In the flexible position, the gunner remotely directs and fires the gun by using the hand control sight assembly and sight mount bracket assembly. The mounting pivot axis system matches the azimuth elevation coordinate system used on the turret; thus, the correct relationship is maintained between the gunner's line of sight and the line of fire of the gun. Within the travel limits of the turret, gun control is independent of the helicopter's flight attitude. The subsystem is equipped with two azimuth and two elevation limit switches and an error circuit. Operation of any of the switches will deenergize the operate relay to prevent firing and extinguish the ARMED indicator light on the control panel assembly.

a. Flexible Firing Position. In firing from the flexible position, the gunner holds the turret control switch depressed and depresses the gun trigger switch. The turret assembly moves the gun with the movement of the sight. When the gunner attempts to acquire a target near the extremes of turret azimuth (60° right, 60° left) or when rapidly giving a large azimuth command signal, the turret may fall out of synchronization with the sight (drive in the opposite direction from that commanded). A flashing reticle display will indicate that the gun cannot be fired. To regain synchronization—

- (1) Release turret control switch.
- (2) Allow turret to assume stow position.
- (3) Position sight near 0°.
- (4) Depress turret control switch.
- (5) Sight on target.

b. Stow Firing Position. When the turret control (fig 11-8) switch is released by the gunner, the turret returns to the stow position with the gun pointing forward at the elevation shown on the GUN ELEV stow control wheel. The turret can be stowed in positive 5° increments of elevation between +15° and -35°. When the sight assembly is not in use, either the gunner or pilot can fire the gun by depressing the firing switch on either cyclic stick.

Warning: Due to gun and subsystem design (para 11-12a), one round will be fired after the gun trigger or cyclic stick firing switch is released (maximum time delay approximately 0.8 second). Therefore, disengagement from the target must be delayed until the trigger switch has been released and the next round fired.

11-12. Dynamic Braking

To insure safe operation of the subsystem, the

gunner must fully understand the function of dynamic braking of the gun drive motor. Dynamic braking is used to insure that the gun will always be stopped in a safe condition after each firing cycle.

a. Time Delay Relay Energized. When the trigger switch is released, a time delay relay will remain energized until the relay is opened by the recoil produced from firing a round. The time delay is incorporated in the circuitry to insure passing a misfired round through the weapon so that it will stop in a safe position. The time delay circuit is set to deenergize the time delay relay 0.8 second after release of the trigger switch.

(1) When no recoil is produced after release of the trigger switch (e.g., when a firing pin is broken or ammunition is expended), the time delay circuit will permit the gun to move through two cycles before deenergizing the time delay relay.

(2) The time delay permits the gun to be driven through two or three misfires in succession before producing recoil by firing a good round. In a typical misfire, or a misfire at the instant of trigger release, the gun will eject the misfire, fire the next round and produce recoil, and then be stopped by dynamic braking (*b* below).

(3) The time delay normally allows firing of one round after release of the trigger switch.

o. Time Delay Relay Deenergized. When the time delay relay is deenergized, power is removed from the gun coil of the gun relay and applied to the braking coil. The contacts of the braking coil now reverse the connection of the motor field winding with respect to the armature, and the two windings in series are shorted. The motor now becomes a shorted series generator that produces torque in the opposite direction to brake the gun.

11-13. Emergency Operation

a. Malfunction in azimuth and elevation. If the subsystem fails to respond in azimuth and/or elevation, maneuver the helicopter to keep fire on the target.

b. Runaway Gun. If a runaway gun occurs, place the GUN POWER toggle switch in SAFE position and place MAIN POWER toggle switch in OFF position.

11-14. Maintenance and Troubleshooting Procedures

For maintenance and troubleshooting procedures, see TM 9-1010-207-12.

Section II. M21 ARMAMENT SUBSYSTEM

11-15. Capabilities

The M21 helicopter armament subsystem (fig 11-22) provides the ground force commander with an immediately responsive and highly mobile means for armed reconnaissance and continuous direct fire support. The weapons subsystem—

a. Can deliver offensive or defensive area fires by means of rockets or automatic guns against personnel in the open, soft material targets, and lightly armored vehicles.

b. Has dual-weapon capability permitting selection of the best weapon for the target or simultaneous engagement of two area targets.

c. Is capable of selective fire in the following modes:

(1) *High rate 7.62mm automatic guns.*

(a) Flexible, using gunner's flexible sighting station.

(b) Stowed, using the XM60 infinity sight and the firing switch on the cyclic control stick.

(2) *2.75-inch folding fin aerial rocket (FFAR).*

(a) Pair—single rocket from each launcher.

(b) Ripples of 2, 3, 4, 5, 6, or 7 pairs (14 rockets).

d. Will function satisfactorily in all coordinated helicopter positions or attitudes and within helicopter speed range of 0 to 140 knots.

e. Has rocket launchers that can be electrically or manually jettisoned in case of in-flight emergency.

f. Can be operated in all tactical environmental conditions in which the helicopter can operate.

g. Has a high degree of accuracy when both

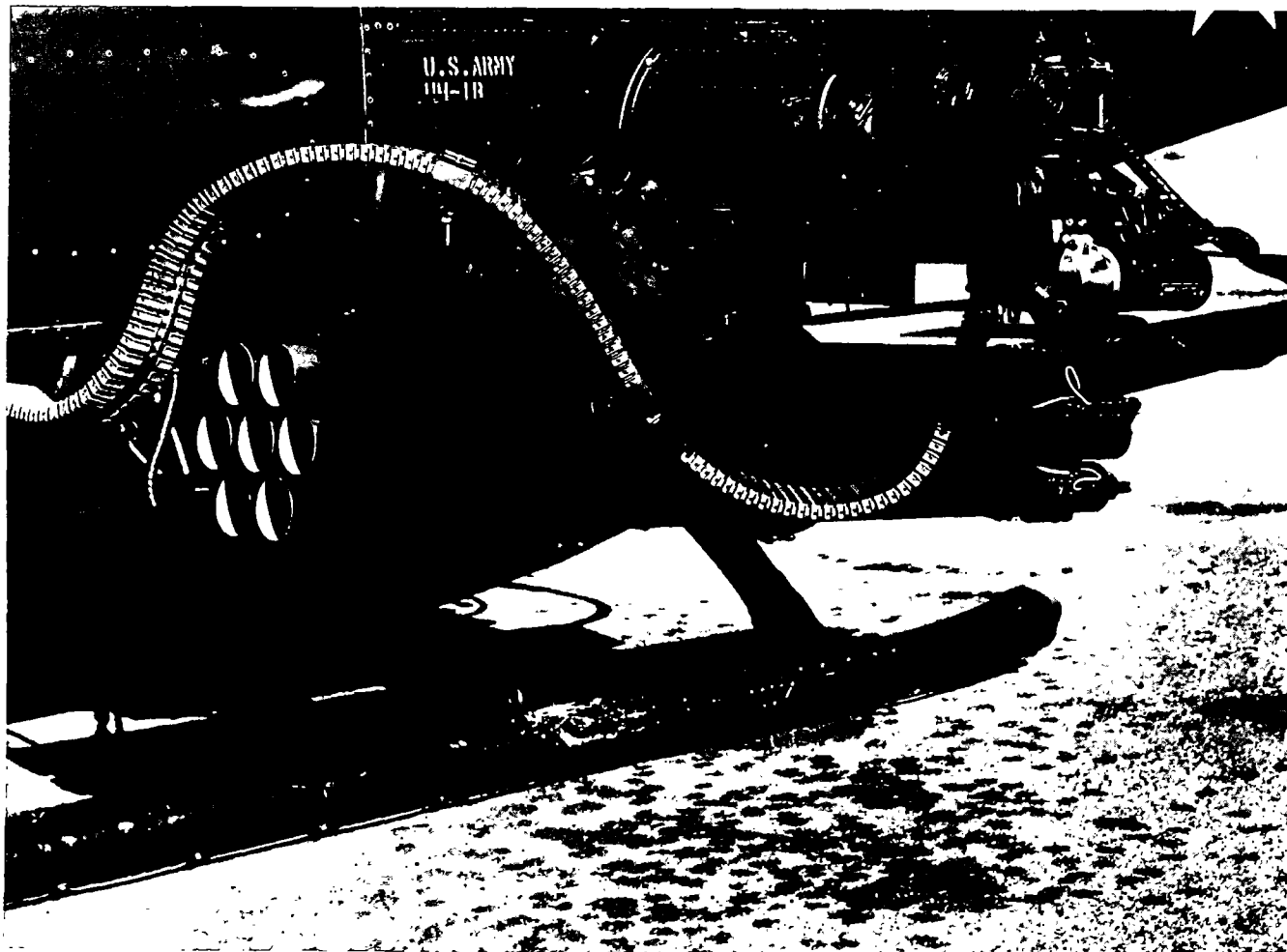


Figure 11-22. M21 armament subsystem.

guns are boresighted or harmonized to converge at 1,000 meters and the rocket launchers are boresighted to converge rocket fires at 1,250 meters.

h. Has the following tabulated data:

- (1) *Maximum effective range.*
 - (a) 7.62mm automatic guns—1,000 meters.
 - (b) 2.75-inch FFAR—2,500 meters.
- (2) *Minimum safe slant range.*
 - (a) 7.62mm automatic guns—100 meters.
 - (b) 2.75-inch FFAR—300 meters.
- (3) *Maximum range.*
 - (a) 7.62mm automatic guns—3,450 meters.
 - (b) 2.75-inch FFAR—9,300 meters with new motor and 10-pound warhead.
- (4) *Ammunition capacity.*
 - (a) 7.62mm automatic guns—6,400 rounds
 - (b) 2.75-inch FFAR—14.
- (5) *Rate of fire.*
 - (a) *7.62mm automatic guns.*
 1. Each, normal—2,400 shots per minute.
 2. Each, high—4,000 shots per minute (one gun at a time).
 3. Both, 4,800 shots per minute.
 - (b) Rockets—6 pairs per second.
- (6) *Muzzle velocity, 7.62mm ammunition—*2,850 feet per second.
- (7) *Weight—*1,108.06 pounds.
- (8) *Flexible limits (automatic guns only)—*
 - + 10° up.
 - 85° down.
 - 12° inboard.
 - 70° outboard.
- (9) *Length of burst, 7.62mm automatic guns—*3-seconds maximum.

i. Is designed so that the automatic guns and rocket launchers can easily and quickly be replaced if rendered inoperative by combat damage.

j. Can be detached quickly from the helicopter and transported by Army utility aircraft or motor vehicle.

11-16. Limitations

The M21 armament subsystem is vulnerable to all types of air defense fires, including small arms, and has the following limitations:

a. Effectiveness of operation is reduced at night and during periods of low visibility due to limitations in target acquisition and range estimation.

b. Engagement of targets is limited by the subsystem's gun/launcher limits in relation to target range, altitude, airspeed, and helicopter degree of bank.

11-17. Description

The M21 armament subsystem has two high-rate-of-fire 7.62mm M134 automatic guns combined with two M158A1, 2.75-inch rocket launchers (fig 11-23 and 11-24).

11-18. Automatic Gun Components

a. *M134 7.62mm automatic guns.* Each of two automatic guns is an electrically driven, air-cooled, six-barreled weapon which fires 2,400 to 4,000 shots per minute. The electric drive assembly (fig 11-25) rotates the gun in its housing by means of gears. The gun housing contains a camway in which the six bolts are rotated through their complete firing cycle. The delinking feeder accepts linked ammunition, strips the rounds from the links, ejects the links, and feeds the rounds into the chambers.

(1) An important safety feature is that each gun is completely cleared after each firing burst. Whenever a gun ceases to fire, a minimum of six live rounds will be cleared through each feeder and ejected overboard.

(2) On the ground, positive safing of the guns can be accomplished by removing the safing sector (fig 11-25) on each gun. This action removes that portion of the camway which guides the bolts and rounds into the chambers.

(3) With the gun mounts in the stow position, the electric drive assembly motor will only receive enough voltage to drive the gun at a rate of 2,400 shots per minute.

(4) When moving the mounts through the field of deflection, one mount must stop at its inboard limit. Upon reaching the inboard limit, the gun will cease to fire and the opposite gun will accelerate to 4,000 shots per minute; therefore, with both guns operational, the constant rate of fire is 4,800 rounds per minute. This rate can be reduced to 2,400 rounds per minute by selecting one gun (left or right) with the GUN SELECTOR switch (fig 11-26) on the control panel.

b. *Control Panel.* The control panel (fig 11-26) contains—

(1) An OFF-SAFE-ARMED switch for the subsystem.

(2) A GUN SELECTOR switch which permits either the LEFT or RIGHT gun or ALL (both) guns to be selected for firing.

c. *Control Box Assembly.* The control box assembly (fig 11-23) is located in the aft baggage compartment. It contains circuit breakers, relays, and other electrical components to control the guns.

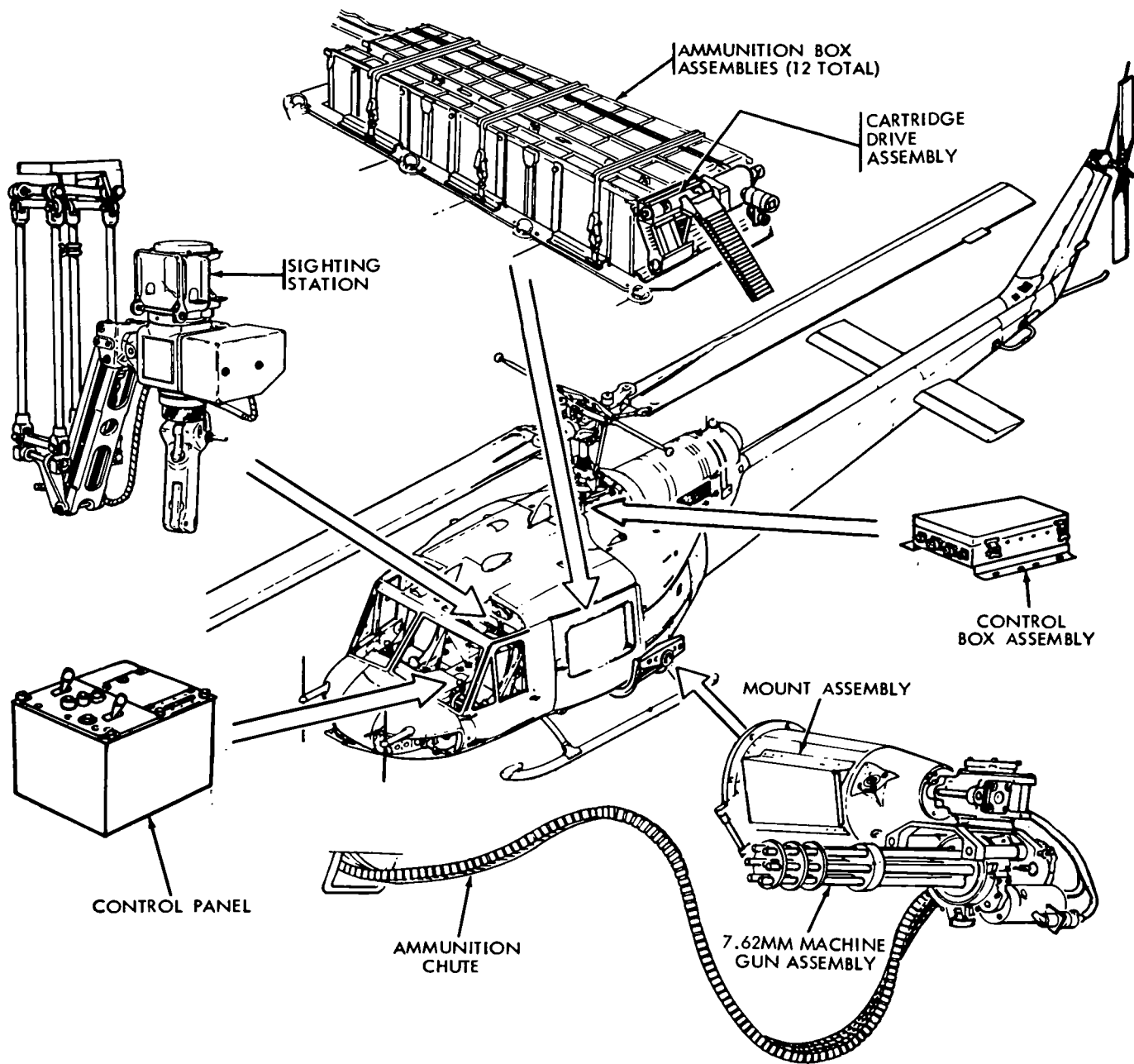
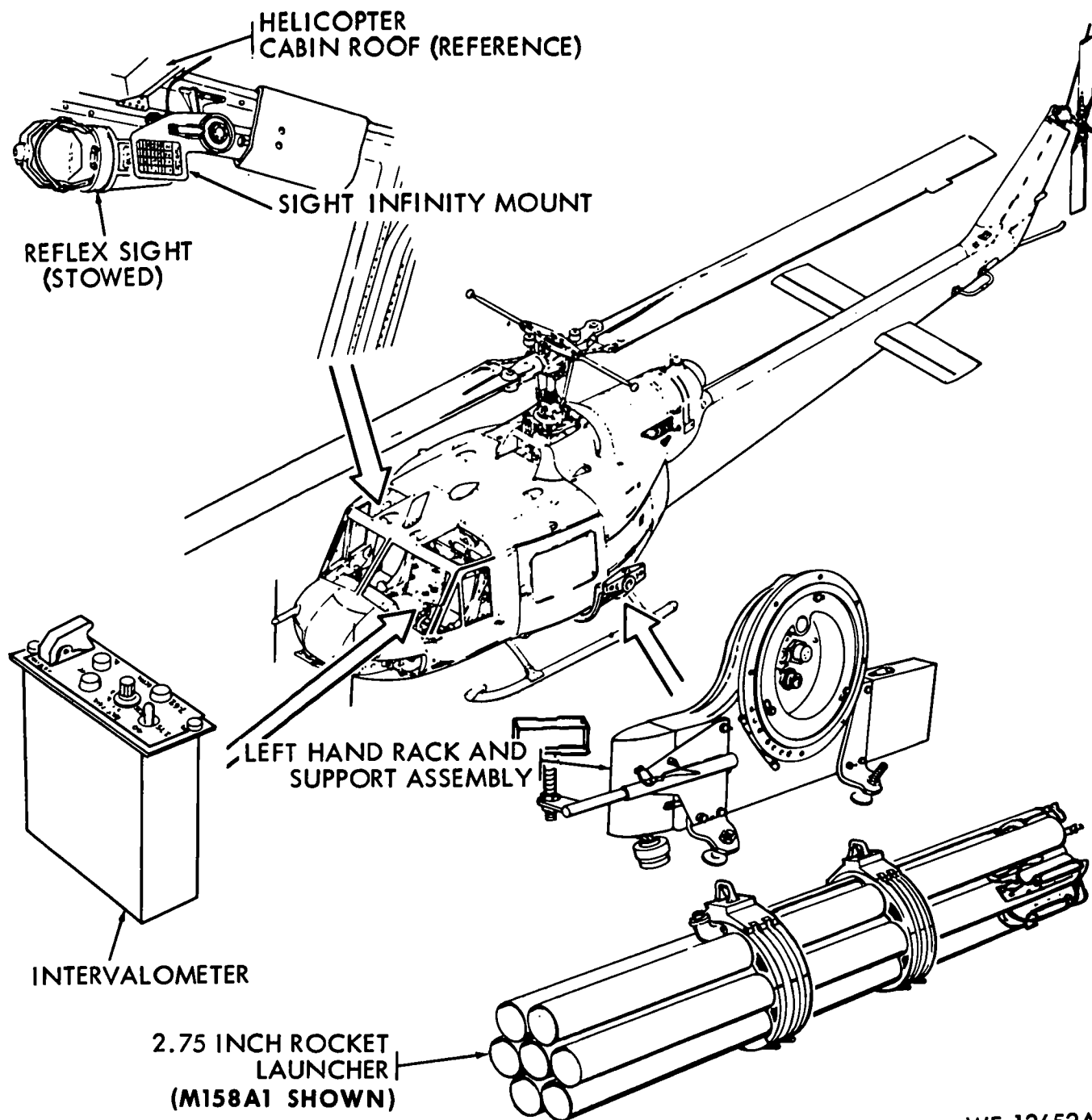


Figure 11-23. Automatic gun components.

d. 7.62mm Ammunition Storage Assembly. The 12 ammunition boxes (four rows of three boxes each) (fig 11-23) hold 6,000 rounds with the right and left ammunition chutes holding an additional 400 rounds. The ammunition is fed through the flexible chuting to the delinking feeder on each gun. The left-hand crossover cartridge drive is attached to the end boxes of the two forward rows. By electrical power, it pulls ammunition from the primary or secondary row of boxes to feed the left gun. The right-hand crossover cartridge drive is attached to the end boxes of the

two rear rows and feeds ammunition to the right gun.

e. Flexible Automatic Gun Sighting Station. The copilot-gunner uses the flexible automatic gun sighting station (fig 11-23) to aim and fire the guns in the flexible mode. The sighting station controls allow the gunner to remotely position the guns within the flexible limits of $+10^\circ$ in elevation to -90° depression and from 12° inboard traverse to 70° outboard. When not in use, the sighting station may be stowed over the gunner's head.



WE 13652A

Figure 11-24. Rocket launcher components.

11-19. Rocket Launcher Components

a. *2.75-Inch Rocket Launcher, M158A1.* Each M158A1 rocket launcher (fig 11-24) has seven tubes firing 2.75-inch folding-fin aerial rockets. The launchers are reusable and the launcher tubes replaceable individually.

b. *Intervalometer.* The intervalometer (fig 11-24) contains—

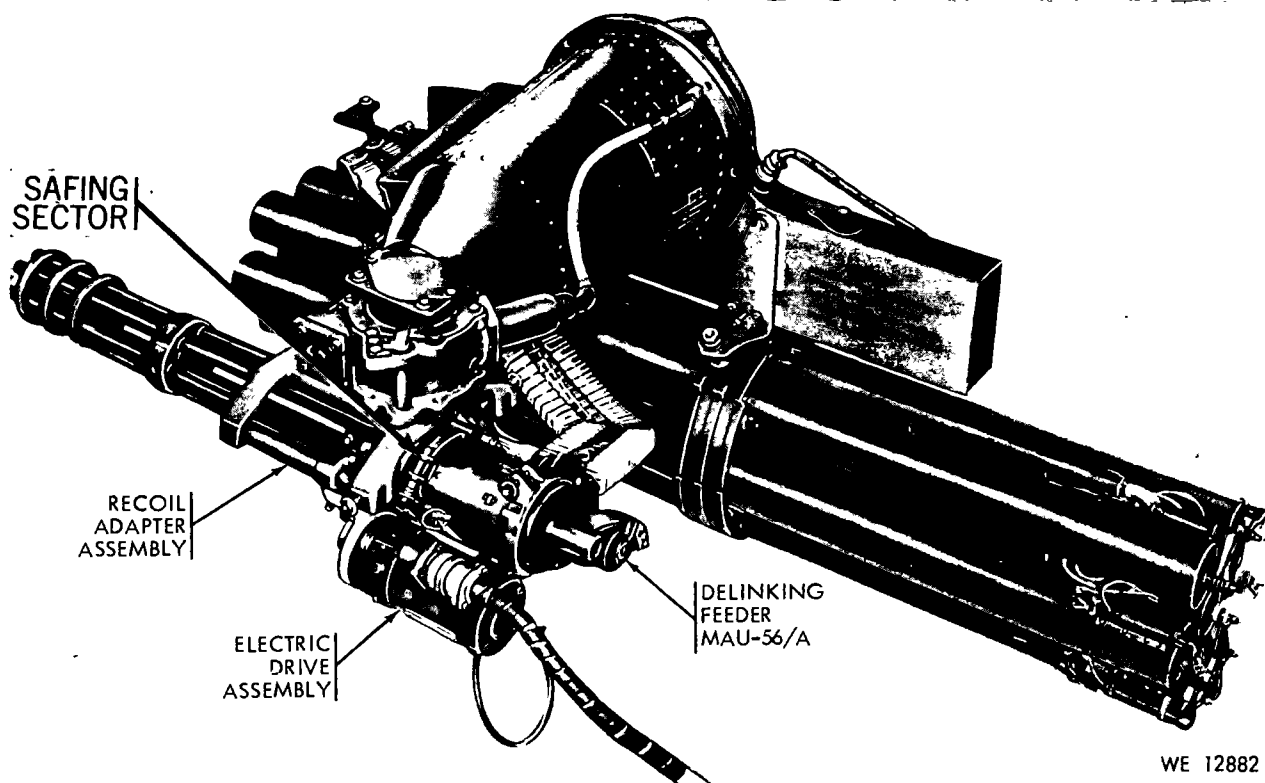
(1) A three-position armament selector switch.

(a) The 7.62 position selects the automatic guns as the primary weapon.

(b) The 2.75 position selects the rockets as the primary weapon.

(c) The 40 position is not used with the M21 subsystem.

Caution: Do not use the 40 (40mm) position as a safety position. Depression of the firing switch with the armament selector switch in this position will result in the firing of rockets.



WE 12882

Figure 11-25. Gun and rocket launcher.

(2) A rocket PAIR SELECTOR switch for the selection of from one to seven pairs of rockets.

(3) An electrical JETTISON switch for the rocket launchers.

(4) A rocket RESET switch to reset the rack and support assembly firing switches.

c. XM60E1 Infinity Sight. The pilot uses the XM60/XM60E1 infinity sight (fig 11-27 and 11-41) to aim the rockets and the stowed automatic guns. When this sight is not in use, it may be stowed near the helicopter's ceiling in front of the pilot (fig 11-24).

11-20. Automatic Gun Firing Procedures

The automatic gun portion of the subsystem may be put into operation in either the stow or flexible mode. Three seconds after depression of the firing switch on the cyclic stick or flexible sighting station, a burst limiter will stop the firing. Each gun ceases firing and clears itself by continuing to drive without being fed ammunition. A minimum of six live rounds will be cleared through each feeder and ejected overboard. By releasing the firing switch during a burst or by activating the limit switches, the guns will clear. The gunner can fire the 7.62mm subsystem automatic guns from the stow or flexible position, while the pilot-gunner can only fire the subsystem from the stow position.

a. Stow Mode. The guns may be stowed in a predetermined position and fired as a fixed weapon by the gunner or the pilot. This permits straight-ahead firing in an emergency by use of the firing switch on the pilot's or gunner's cyclic stick. To fire the automatic guns in the stow position, the armament selector switch is moved to 7.62 and the OFF-SAFE-ARMED switch to ARMED.

(1) *Stow fire by the pilot.* The pilot uses the XM60 infinity sight for stow fire by turning the elevation depression knob until the sight reticle pipper coincides with the strike of the bullets. When using the sight to observe the strike of tracers fired from fixed guns, the pilot changes the attitude of the helicopter to aim the guns; therefore, accuracy of fire delivery is limited by helicopter maneuverability.

(2) *Stow fire by the gunner.* There is no sight for stow fire at the gunner's station; however, the gunner may provide his own reference marks on the windshield. To verify his constant head position, he fires a few rounds and places a line on the windshield that coincides with the observed strike of the bullets. He can place a dot or circle on this line to coincide with the center of bullet strike.

b. Flexible Mode. For flexible mode operation, the gunner's procedure is to—

(1) Disengage the sighting station (fig

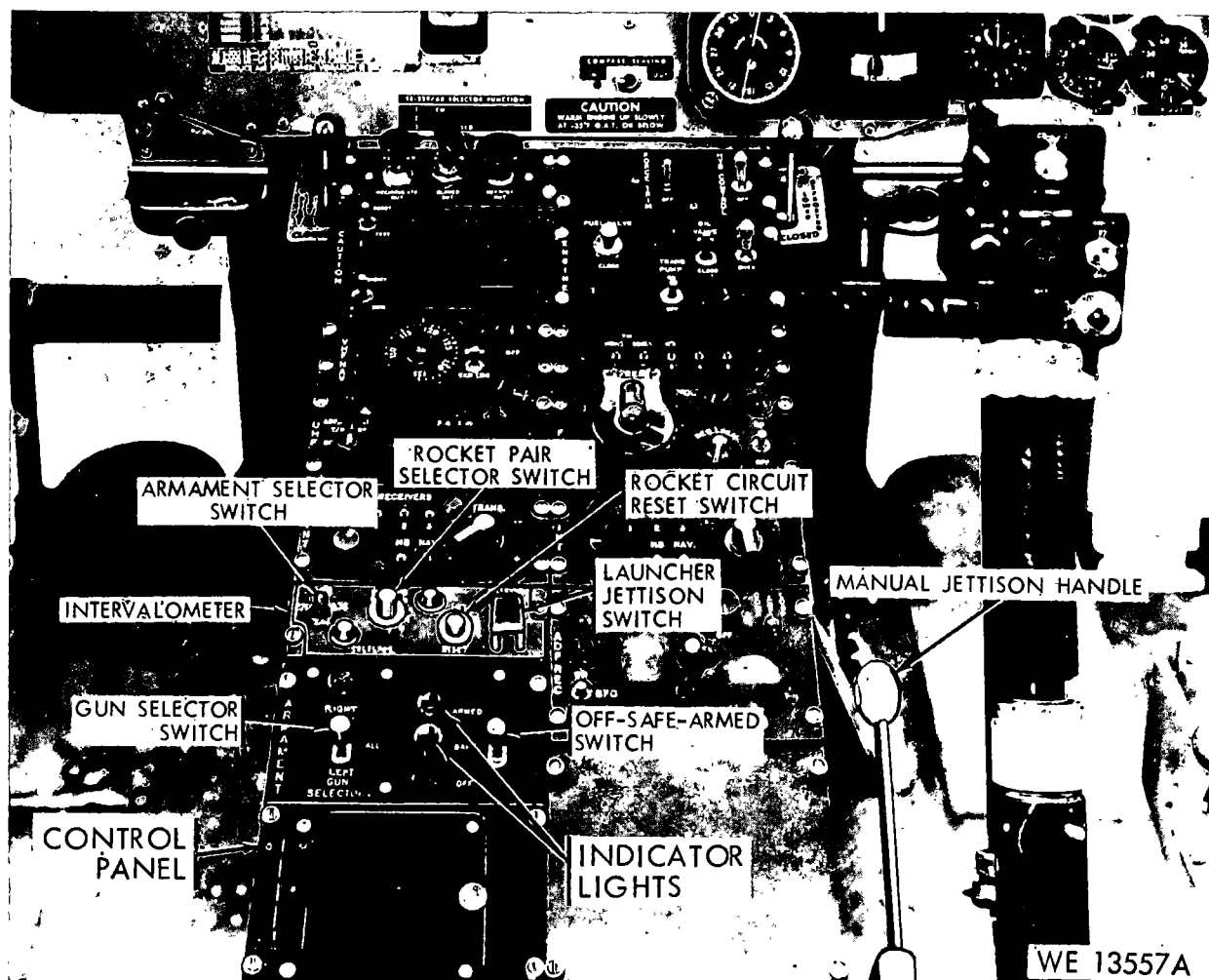
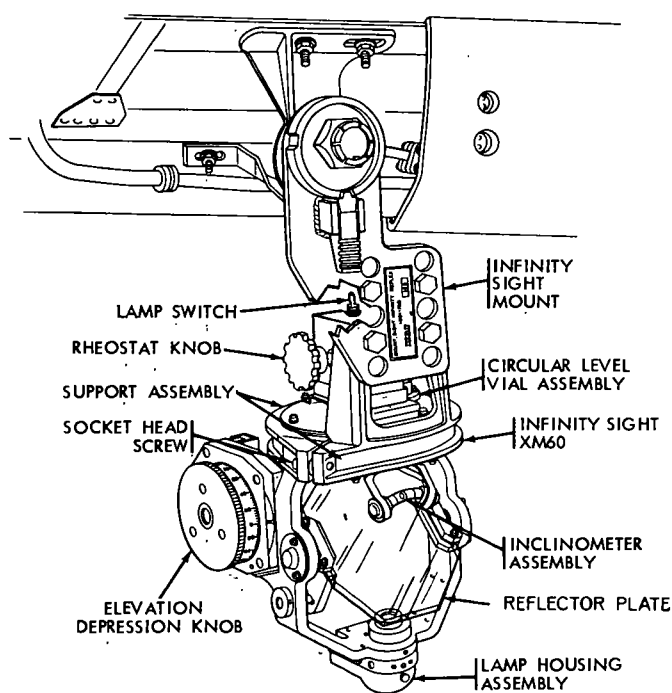


Figure 11-26. Control panel and intervalometer.



WE 12713

Figure 11-27. XM60 infinity sight.

11-28) from its stowed position, grasp the control handle, and pull down outboard.

(2) Move the reticle lamp switch (fig 11-28) either forward or aft of the center off position to illuminate the reticle lamp. (Two filaments are used in the reticle lamp to insure reticle illumination during action. Should one filament burn out, move the switch to the opposite position to reilluminate the reticle.)

(3) Turn the rheostat knob (fig 11-28) to set reticle light intensity at desired level during night operations.

(4) Depress the actuator bar on the control handle to transfer firing voltage from the cyclic stick firing switches to the control handle trigger switch. Then by moving the sighting station, the gun may be electrically aimed and fired.

Note. When engaging a target in the flexible mode, the gunner always depresses the actuator bar before depressing the trigger switch. He uses the control handle trigger switch as long as the actuator bar is depressed. Whenever the actuator bar is released, control is returned to the stowing potentiometers and the mounts are driven immediately to the stowed position. Simultaneously, electrical

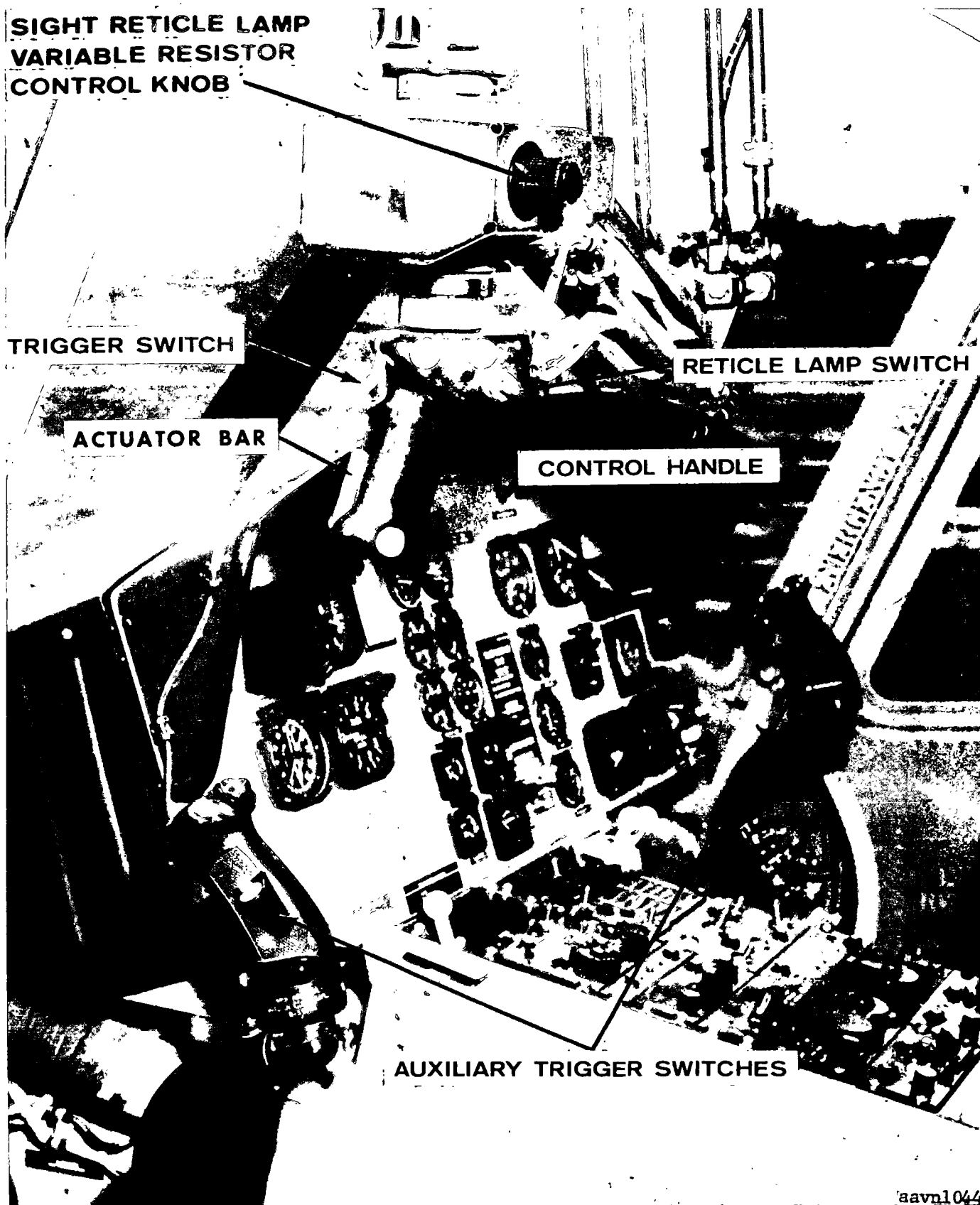


Figure 11-28. Helicopter armament controls (sighting station).

power is transferred from the control handle trigger switch to the cyclic stick firing switches.

11-21. Rocket Firing Procedures

The 2.75-inch rocket launchers are fixed to the support assembly and can only be fired from the stow position. When the armament selector switch is positioned at 2.75, the primary subsystem mode is rocket firing by means of the cyclic stick firing switches. However, automatic gun firing can still be accomplished by using the flexible sighting station (para 11-20b above). While firing rockets, the automatic gun firing will be interrupted as long as the cyclic stick firing switch is depressed. Rocket firing procedures are as follows:

a. Before Takeoff.

(1) Close the 7.62mm, rocket jettison, and XM60 sight circuit breakers.

(2) Position the OFF-SAFE-ARMED switch to SAFE and check to see that the green SAFE indicator light illuminates.

(3) Position the armament selector switch (on the intervalometer control panel) to 7.62. This will prevent accidental rocket firing before takeoff.

(4) Check to insure that the rocket PAIR SELECTOR switch is indicating zero pairs.

(5) Depress the RESET switch (on the intervalometer control panel) to reset the firing switch on each rack and support assembly.

Caution: Do not use the cyclic firing switch to recycle the rack firing switches.

(6) Conduct an operational check of the XM60/XM60E1 infinity sight (fig 11-27) as follows:

(a) Depress the locking lever to disengage the sight from the stow indent, then swing the sight outboard and down from its stowed position until the locking lever engages the operate indentation.

(b) Move the reticle lamp switch either forward or aft of the center off position, to illuminate the reticle lamp. (Two filaments are used in the reticle lamp to insure illumination during action. Should one filament burn out, move the switch to the opposite position to reilluminate the reticle.)

(c) Turn the rheostat knob to set the reticle light intensity to desired level.

(d) Set desired scale reading at the fixed index scale on the sight.

b. After Takeoff.

(1) Prepare for firing by setting the armament selector switch to 2.75 and the rocket PAIR SELECTOR switch to the desired number of rocket pairs to be fired.

(2) Position the OFF-SAFE-ARMED switch to ARMED and check to see that the SAFE indicator light goes out and that the ARMED indicator light illuminates.

(3) Using the sight reticle pipper (center of reticle, fig 11-38) as a reference aiming point, acquire the target by flying a target-collision course, changing the attitude of the helicopter as necessary to align the sight reticle on the target.

(4) When the proper sight picture has been developed, fire the rockets by depressing the firing switch on the cyclic control stick.

(5) After firing, position the—

(a) OFF-SAFE-ARMED switch to SAFE.

(b) Armament selector switch to 7.62.

(c) Rocket PAIR SELECTOR switch to zero pairs.

(6) Before helicopter shutdown, position the OFF-SAFE-ARMED switch to OFF and then open all armament circuit breakers.

11-22. Emergency Procedures

a. Automatic Gun Emergency Procedures.

(1) *Guns fail to fire.*

(a) Make sure that the 7.62mm and M21 GUN POWER circuit breakers are pushed in and that the following switches are in the positions indicated:

1. OFF-SAFE-ARMED switch—ARMED.

2. Gun selector switch—7.62.

3. Actuator bar—depressed.

(b) Press gun trigger switch on sighting station grip assembly. If guns fail to fire, release grip assembly and move OFF-SAFE-ARMED switch to SAFE. Recheck positions in (a) above, then move ARMED-SAFE-OFF switch to ARMED. Attempt to fire the guns by depressing the firing switch on either cyclic stick. If guns still will not fire, place the OFF-SAFE-ARMED

switch on SAFE, pull out the M21 GUN POWER circuit breaker, and immediately upon landing, remove the safing section.

(2) *Runaway guns.* If guns continue to fire after the trigger switch on the grip assembly has been released, immediately release the actuator bar and grip assembly, place the OFF-SAFE-ARMED switch in OFF position, and pull out the M21 GUN POWER circuit breaker.

(3) *Single gun malfunction.* If a malfunction or emergency (e.g., runaway gun) occurs in only one gun, isolate this gun from the firing circuit by selecting the opposite gun with the gun selector switch.

b. Rocket Emergency Procedures.

(1) *Jettisoning.* To reduce fire and explosion hazards in a rocket launcher or in an emergency requiring a forced landing, jettison loaded rocket pods. In the case of a rocket hangfire in the launcher, the tactical situation may permit the pilot to salvo all remaining rockets into the target area while retaining the burning rocket in the launcher and slipping the helicopter to keep the fire away from the helicopter. However, pods should not be jettisoned during apparent sideslip (when the needle and ball are not centered in the turn and slip indicator). Jettison during sideslip may result in damage to the helicopter. Jettisoning can be safely accomplished during hovering, climbing, and level flight in the speed range from zero to 100 knots, and during autorotation and descending flight up to 80 knots. To jettison—

(a) Lift the red switch guard to break copper safety wire on launcher jettison switch (fig 11-26).

(b) Push launcher jettison switch forward and check support assemblies to insure that jettison is complete.

(c) If launchers fail to jettison, check to insure that jettison circuit breaker is closed, then attempt jettison again.

(d) If launchers will not jettison electrically, pull manual jettison handle located on the right side of the pedestal console (fig 11-26).

(2) *Failure to fire.* If there is a misfire, continue the firing mission until all other rockets have been fired. With the helicopter pointed toward a safe impact area, set the OFF-SAFE-ARMED switch to SAFE position and push the

reset switch. Switch back to ARMED, set the selector switch to seven pairs, and depress firing button on the cyclic control stick. If rockets fail to fire, repeat this procedure.

Warning: If the misfired rounds do not fire on this second attempt, position armament selector switch to 7.62, ROCKET PAIR SELECTOR switch to zero pairs, the OFF-SAFE-ARMED switch to OFF; open all armament circuit breakers, and wait 10 minutes before unloading rockets.

(3) *Rocket breakup.* Rockets may break up immediately after launch because of improper handling or assembly, or combat damage. Normally, the 7,000 foot-pounds of initial thrust is sufficient to cause breakup to occur well ahead of the helicopter. Upon seeing a rocket break up, the pilot must avoid flying through the particles of the rocket; a slight cyclic climb will usually be adequate.

11-23. Operational Checks

The operational checks (table 11-4) will be performed to make sure that all controls function properly and that the armament subsystem M21 is in operational readiness.

Warning: Do not attempt to perform the operational checks with either the M134 automatic guns or the M158A1 series rocket launchers loaded with live ammunition.

Caution: Do not dry fire M134 automatic guns with safing sector and housing cover removed.

Note. Checks are made with helicopter armament circuit breakers closed, 28 volts direct-current power on and 1,500 $\pm$ 50 psi hydraulic pressure applied, and aircraft battery connected.

11-24. Boresighting

The following procedures require two persons, one in the helicopter cockpit and the second outside the helicopter. Procedures apply to both sides of the subsystem.

Warning: Remove all ammunition from M134 automatic guns and rocket launchers. Disconnect electric cables from connectors on electric drive assembly, delinking feeder MAU-56/A, and rocket launcher.

a. M134 Automatic Guns and Related Components.

(1) *Target method.*

(a) Jack and level helicopter as instructed

Table 11-4. M21 Armament Subsystem Operational Checks

Check	Control	Action	Result
1	OFF-SAFE-ARMED switch.....	Place in SAFE position.....	SAFE indicator light (green) will illuminate.
2	GUN SELECTOR switch.....	Place in ALL position.	
3	Armament selector switch.....	Place in "7.62" position.	
4	OFF-SAFE-ARMED switch.....	Move to the ARMED position.....	Armed indicator light will illuminate.
5	Trigger switch (cyclic stick).....	a. Press trigger.....	a. M134 automatic guns and cartridge drive assemblies on both sides of helicopter should operate.
		b. Release trigger.....	b. Above action stops.
6	GUN SELECTOR switch.....	Place in LEFT position.	
7	Trigger switch (cyclic stick).....	a. Press trigger.....	a. Right M134 automatic gun and right cartridge drive assembly operate.
		b. Release trigger.....	b. Above action stops.
8	GUN SELECTOR switch.....	Place in RIGHT position.	
9	Trigger switch (cyclic stick).....	a. Press trigger.....	a. Right M134 automatic gun and right cartridge drive assembly operate.
		b. Release trigger.....	b. Above action stops.
10	GUN SELECTOR switch.....	Place in ALL position.	
11	Stow latch assembly (sighting station).....	Press latch and move sighting station down into the operating position. Extend the hand controller pulling it free of the linkage.	Sighting station is now in the operating position.
12	Reticle lamp switch (sighting station).....	Move switch to either side of OFF position.	Reticle lamp should illuminate.
13	Rheostat knob.....	Turn clockwise.....	Intensity of illumination increases.
14	Actuator bar.....	a. Depress actuator bar and move sighting station in azimuth and elevation.	a. M134 automatic guns should follow movement of the sighting station.
		b. Keep actuator bar depressed and press trigger switch.	b. M134 automatic guns and cartridge drive assemblies should operate.
		c. Release actuator bar.....	c. M134 automatic guns should return to the stow position.
15	Firing interrupter switch (mount assembly).	Adjust as instructed in TM 9-1090-202-12.	To keep from firing into the helicopter.
16	a. Pin, quick release (double angle bracket).	Pull pin from bracket.	
	b. Spring lock (sighting station).....	Retract hand controller of sighting station by pushing it up against the linkage to engage spring lock.	This locks hand controller to linkage.
	c. Plunger (sighting station).....	Pull plunger back and swing sighting station upward to engage in double angle bracket. Install pin pulled from double angle bracket (removed in a).	Secures sighting station in the stow position.
17	a. Rack firing switch.....	Set switch so that dot on shaft is aligned with reset (arrow).	
	b. ARMAMENT SELECTOR switch.	Place in the 2.75 position.	
	c. RKT PAIR SELECTOR switch.....	Turn to position number 7.	
	d. Trigger switch (cyclic stick).....	Depress and momentarily hold.....	The dot on the shaft of the rack firing switch should now be adjacent to the number 7.
	e. OFF-SAFE-ARMED switch.....	Place in SAFE position.	
	f. RKT RESET switch (intervalometer).	Depress.....	The dot on the shaft of the switch should now be in reset (arrow) position.
18	a. Locking lever (reflex sight mount).....	Depress locking lever and rotate reflex sight XM60/XM60E1 into operating position.	
	b. Reticle lamp switch (reflex sight XM60/XM60E1).	Place in ON position (check both ON positions).	Reticle image should be visible on reflector plate (beamsplitter).
	c. Rheostat knob.....	Turn clockwise through full travel.....	Reticle light intensity should increase.

Table 11-4. M21 Armament Subsystem Operational Checks—Continued

Check	Control	Action	Result
19	d. Elevation/Depression knob.....	Turn clockwise, then counterclockwise..	A click should be audible as each 5-mil increment passes the index and beam-splitter.
	e. Locking lever (sight mount).....	Depress and return sight to stow position.	Turns on its axis.
	a. OFF-SAFE-ARMED switch.....	Place in SAFE position.	
	Caution: If rocket launchers are installed, do not make next check unless they are supported.		
	b. JETTISON switch (intervalometer).	Raise guard and operate switch.....	Bomb rack should release the rocket launchers.
20	c. JETTISON switch (intervalometer).	Lower guard on switch.	
	d. Bomb rack cocking lever.....	Engage ring of bomb rack cocking lever and pull.	Closes bomb rack hooks to engage suspension lugs on the rocket launchers.
	a. Power supply (helicopter).....	OFF.	
	b. RKT PAIR SELECTOR switch..	On 0 position.	
	c. OFF-SAFE-ARMED switch.....	Place in OFF position.	

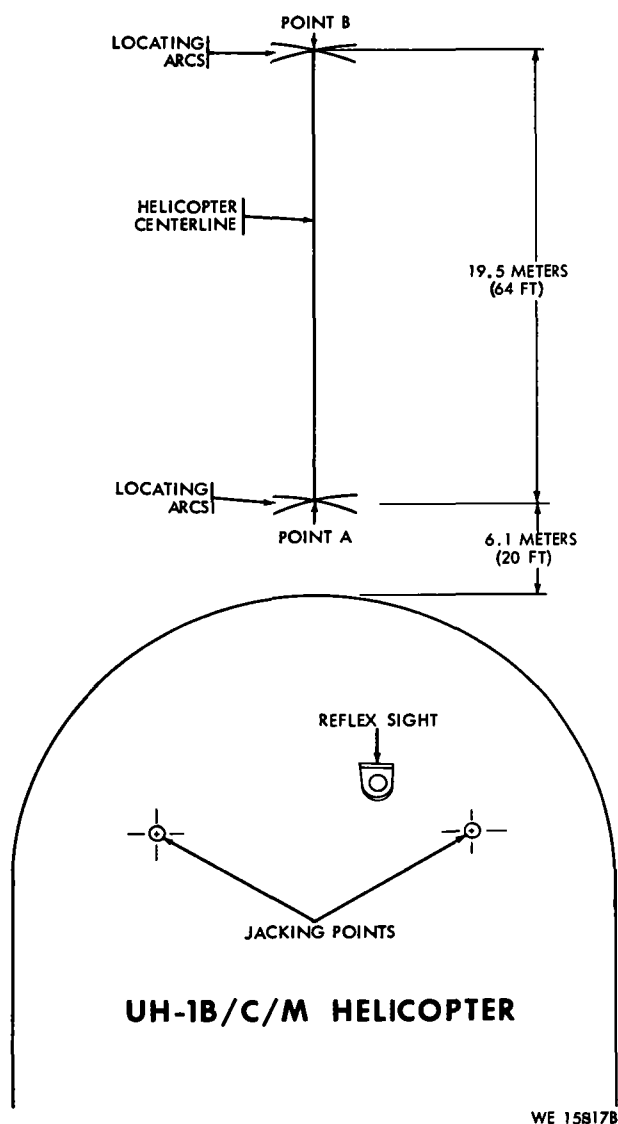


Figure 11-29. Establishing centerline of helicopter.

in TM 55-1520-219-20. Stabilize by blocking under skids where cross tubes attach to skids.

(b) Refer to figure 11-29 and use jacking points as centers. Use a steel tape or wire and describe a pair of locating arcs approximately 6.1 meters (20 feet) in front of the helicopter. Describe a second pair of locating arcs approximately 25.6 meters (84 feet) in front of the helicopter.

(c) Stretch a chalked line between points A and B (fig 11-29) and snap to mark the helicopter centerline.

Caution: Make sure the OFF-SAFE-ARMED switch is in the OFF position before connecting or disconnecting any external power source to the helicopter.

(d) Provide full electrical and hydraulic power to the armament subsystem M21. Use power directly from the helicopter or use an external power source that delivers 28 ± 2 volts direct current electrical power and 1,000 psi hydraulic power.

(e) Make sure automatic gun assemblies are properly installed and secure in the support of the mount assemblies.

(f) Release the sighting station from the stow position.

(g) Tape down the actuator bar and aline the sighting station in deflection as shown in figure 11-30.

(h) Place the OFF-SAFE-ARMED switch

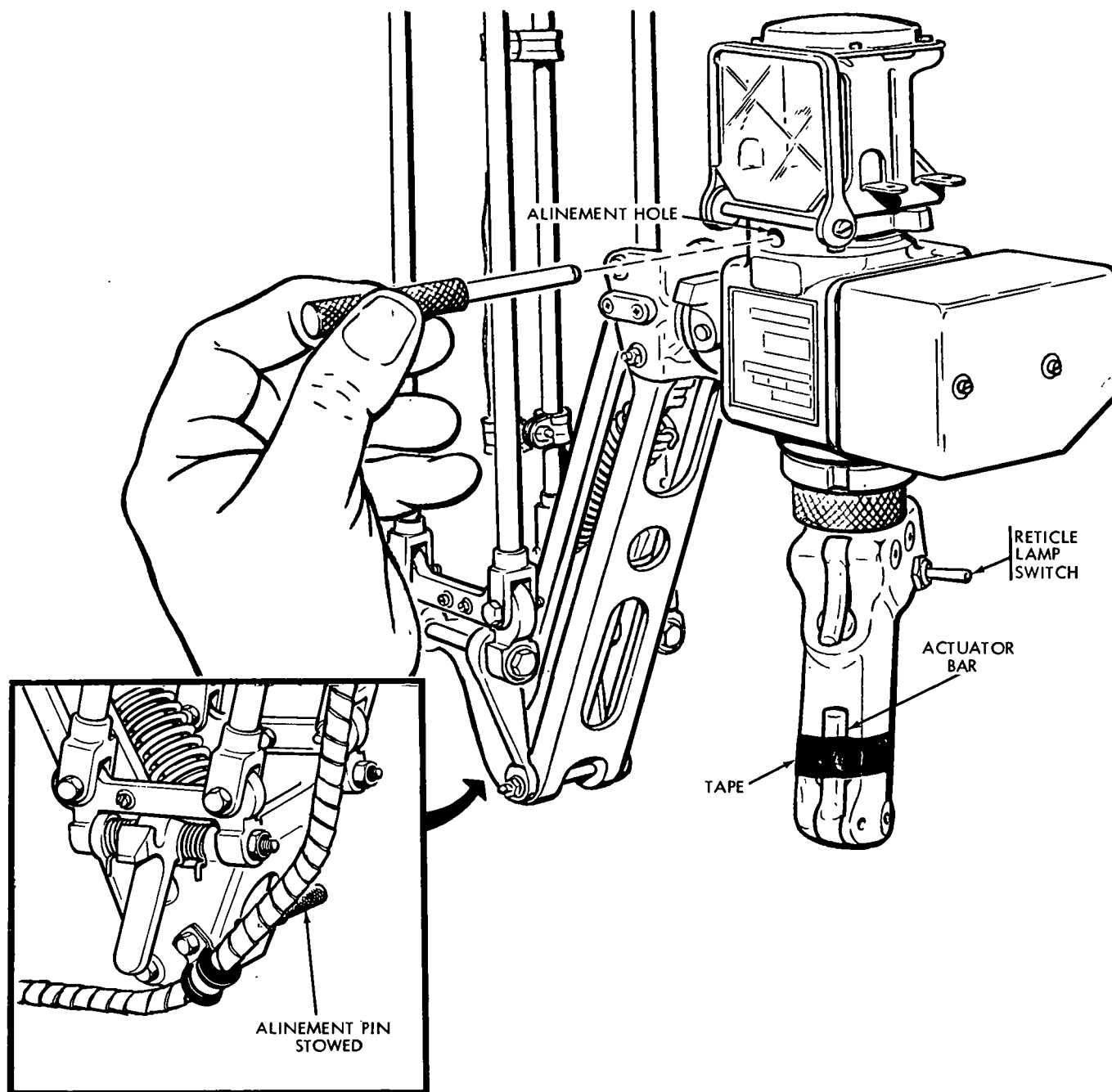


Figure 11-30. Alining sighting station in deflection.

in the ARMED position and turn on the reticle lamp switch of the sighting station.

(i) The second person working outside the helicopter will place the boresight target (fig 11-31) at 1,000 inches in front of the helicopter.

(j) Aline helicopter vertical centerline of boresight target with helicopter centerline established in (b) and (c) above (fig 11-29). At the direction of the man in the helicopter, raise or lower boresight target until center dot of sight

reticle pattern (fig 11-32) of the sighting station is on the sight cross of the boresight target.

(k) Press in on gun timing pin (fig 11-33) and rotate gun barrels in firing direction until gun timing pin depresses.

(l) Insert boresight adapter and boresight into muzzle of gun barrel in firing position (12 o'clock).

Warning: The man operating the sighting station must hold it firm and steady. This will insure proper adjustments of variable resistors

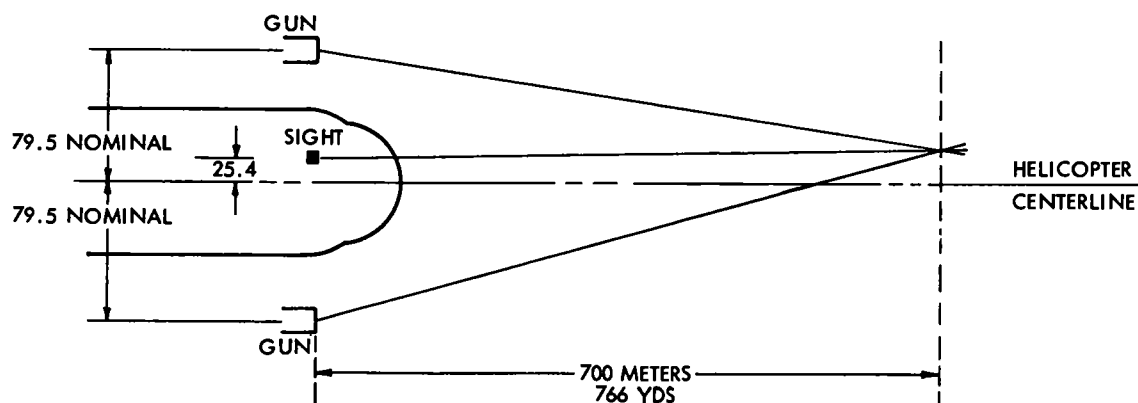
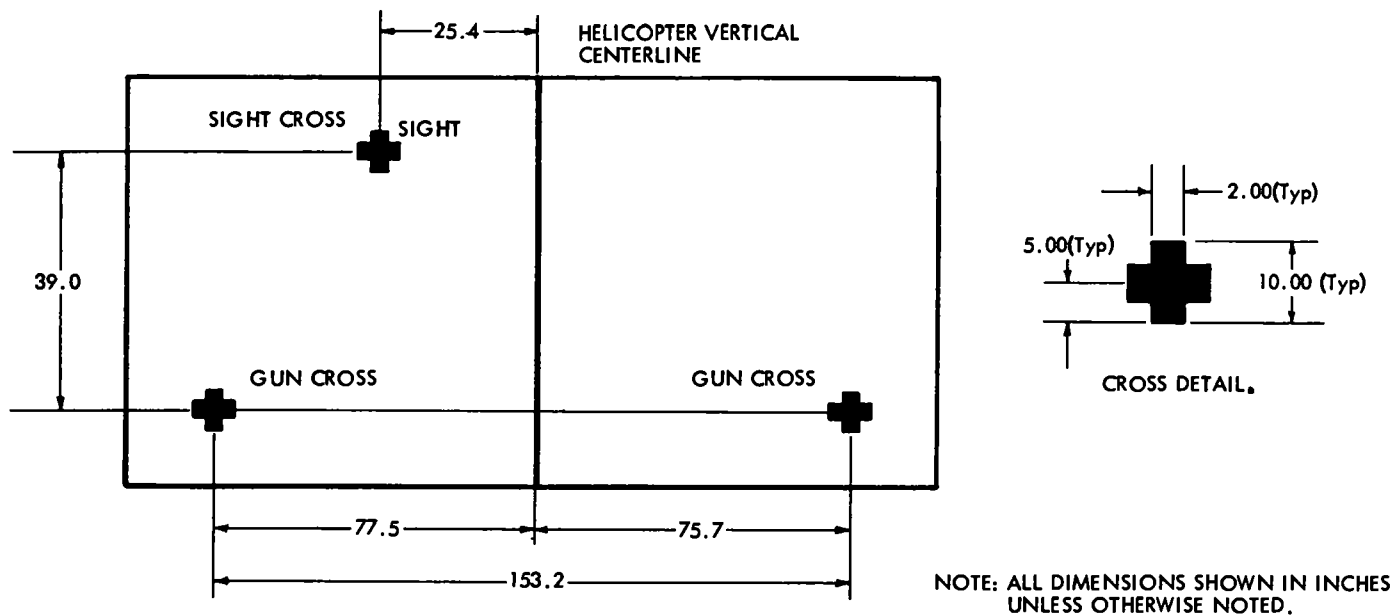


Figure 11-31. Dimension drawing of boresighting target.

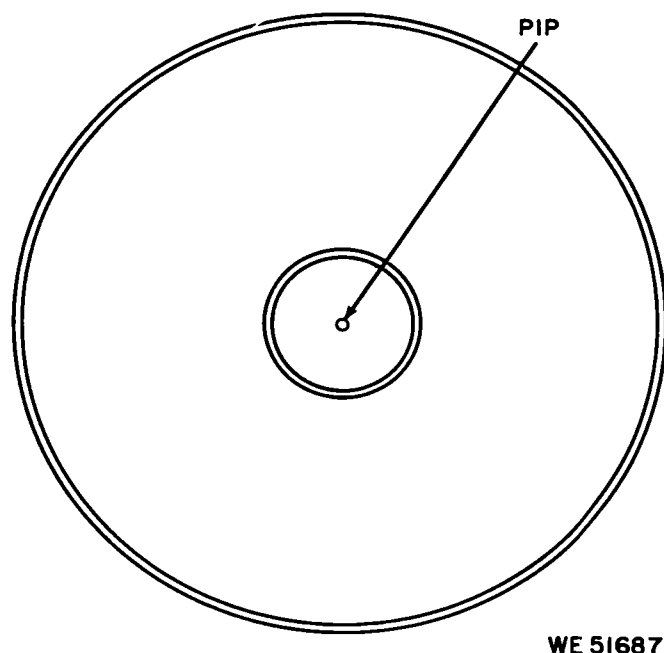


Figure 11-32. Sighting station—reticle pattern.

and prevent severe injury to eye of man sighting through the boresight in the event of a sudden movement of the sighting station.

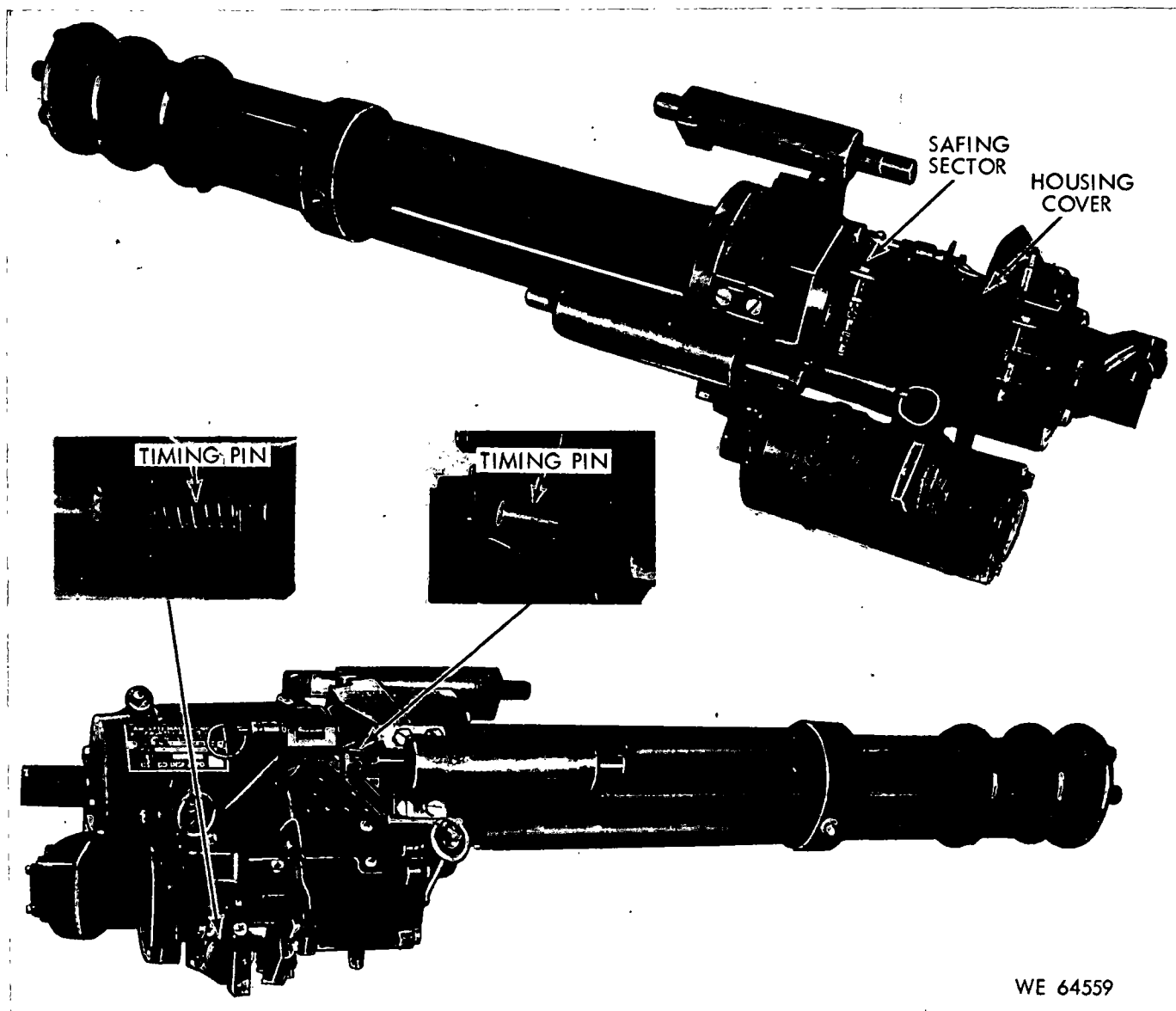
(m) Sight at the boresight target through the boresight. If the boresight reticle image is not on the designated gun cross of the boresight target, adjust the deflection and/or elevation variable resistors in the mount assemblies (fig 11-34, 11-35, and 11-36) until boresight reticle image coincides with gun cross of target.

(n) Remove boresight and boresight adapter from firing barrel and remove tape from actuator bar on sighting station. The mount assembly will move to stow position.

(o) Check to determine that gun timing pin depresses, then insert boresight adapter and boresight in the firing barrel.

(p) Sight at boresight target through the boresight.

(q) If boresight reticle image is not on target mark, the man in the helicopter will adjust the



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Figure 11-33. 7.62mm automatic gun assembly—controls.

deflection and/or elevation stow variable resistors in the control panel as required (fig 11-37).

(2) *Distant aiming point method.*

(a) Locate a distant aiming point at 400-600 meters (437-657 yd) from the helicopter. A tree, vehicle, or corner of a building can be used. Do not use a reference point higher than 10 feet from the ground.

(b) Position the helicopter on a level surface and facing the distant aiming point.

(c) Establish the centerline of helicopter as instructed in (1)(b) and (1)(c) above, so it is aligned with the distant aiming point.

Note. If only the guns are being boresighted, the second pair of locating arcs can be located approximately 15.2 meters (50 feet) in front of the helicopter.

(d) Perform instructions in (1)(d) through (1)(h) above.

(e) Using the sighting station, position the reticle dot on the distant aiming point.

(f) Perform instructions in (1)(k) and (1)(l) above.

Warning: The man operating the sighting station must hold it firm and steady. Any sudden movement of the sighting station could cause severe injury to the eye of the man sighting through the boresight.

(g) Sight at distant aiming point through the boresight. Adjust deflection and/or elevation variable resistors in the mount assembly (fig 11-34, 11-35, and 11-36) until boresight reticle image (fig 11-38) is on distant aiming point.

(h) Repeat instructions in (1)(n) and (1)(o) above.

(i) Sight at the distant aiming point through boresight.

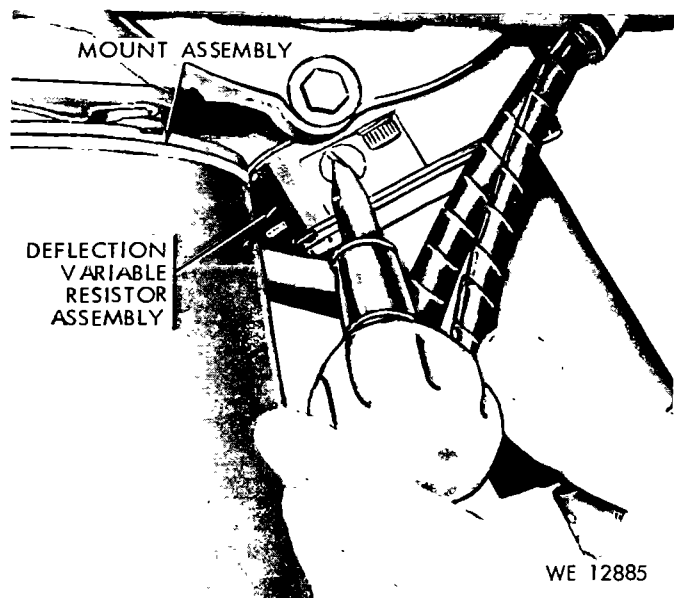


Figure 11-34. Adjusting deflection variable resistor.

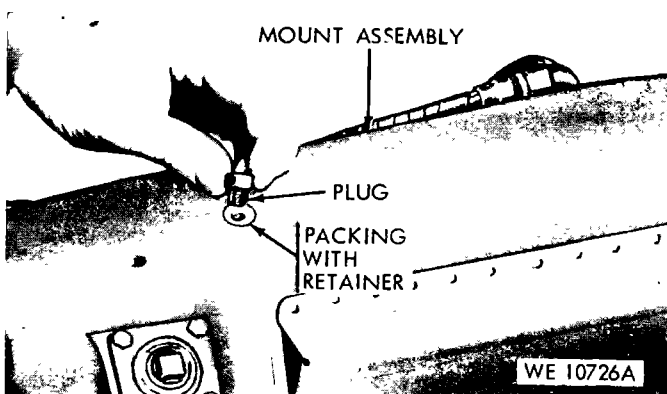


Figure 11-35. Installing/removing elevation variable resistor plug.

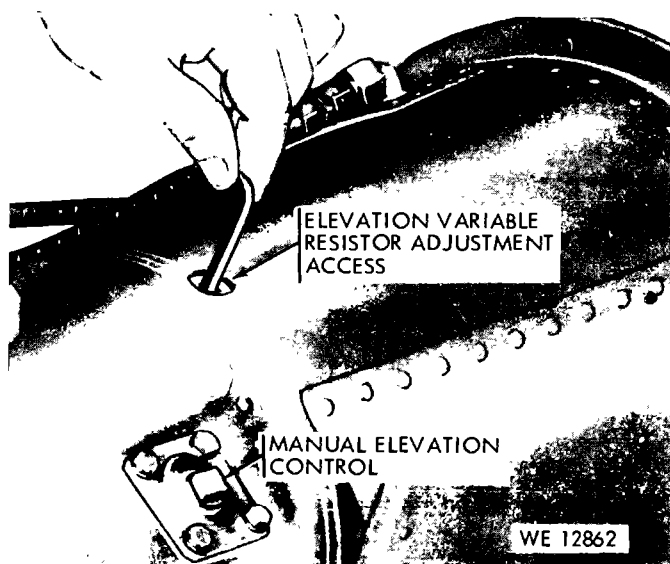


Figure 11-36. Adjusting elevation variable resistor.

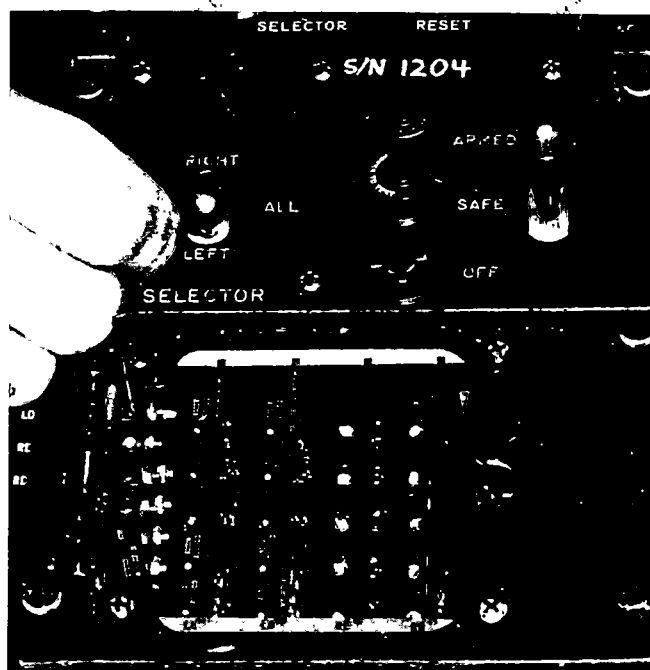


Figure 11-37. Adjusting deflection/elevation stow variable resistor.

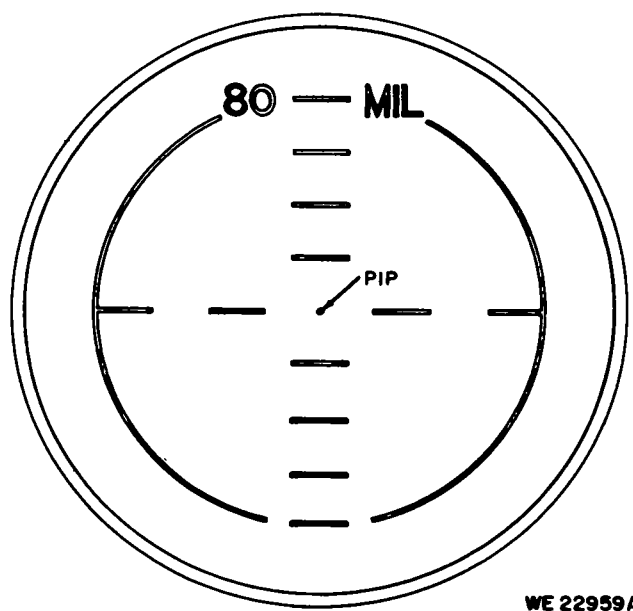


Figure 11-38. Reflex sight XM60/XM60E1—reticle pattern.

(j) If boresight reticle image is not on the aiming point, the man in the helicopter will adjust the deflection and/or elevation stow variable resistors in the control panel as required (fig 11-23).

b. Rocket Launchers and Related Components.

Warning: Do not attempt boresighting with rockets loaded in rocket launchers. Unload all rockets before proceeding.

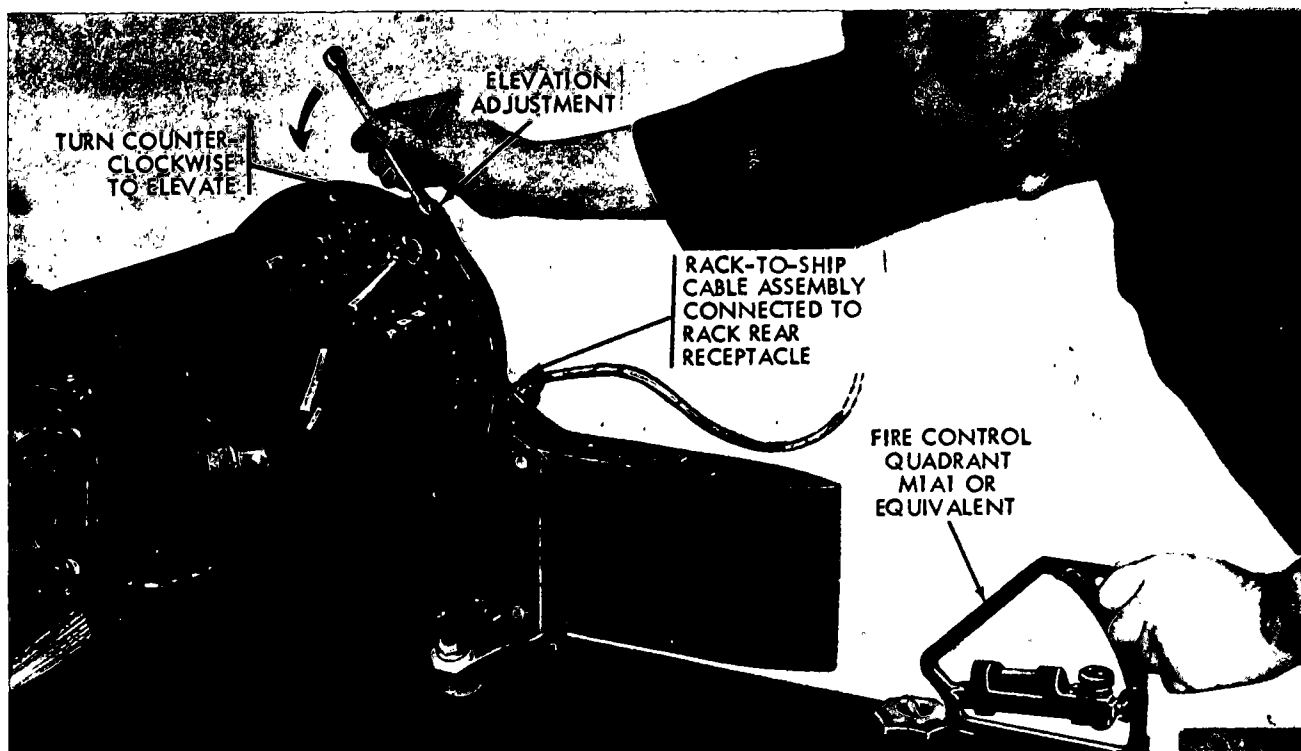


Figure 11-39. Adjusting rack and support assembly in elevation—left side shown.

(1) Adjust rack and support assembly, following the procedure shown in figure 11-39.

(2) Boresight rocket launchers as shown in figure 11-40.

(a) Loosen clamping screw of reflex sight (fig 11-41) and align sight approximately parallel to centerline of helicopter.

(b) Adjust sight in support until level vial and inclinometer show sight is level.

(c) Turn on reticle lamp and adjust sight in azimuth until sight pip will track a line parallel to helicopter centerline when beamsplitter is rotated through full travel.

(d) Tighten clamping screw of sight.

(e) Set beamsplitter at approximately 105 mils elevation. Jack and reposition helicopter as necessary to put sight pip on distant aiming point.

(f) Loosen left rocket launcher sway braces. Install optical boresight in center tube of launcher.

(g) Adjust boresight alining screws (fig 11-42) until boresight is on distant aiming point. Tighten sway braces flush with launcher hard points, tighten another quarter turn, and lock.

(h) Repeat steps (f) and (g) above for rocket launcher on righthand side of helicopter.

(i) Loosen boresight alining screws one-fourth turn.

11-25. Harmonization

After aircraft and weapons preflight, start the helicopter. Immediately after completing the standard starting procedure, close the three circuit breakers marked M21 on the armament circuit breaker panel above the pilot's position. Next, place the ARMED-SAFE-OFF switch, located on the control panel, to SAFE; allow the system to warm up before operation. This preliminary step eliminates the possibility of boresight drift due to uneven heating of the four amplifier board variable resistors, located under the access cover of the control panel. If possible, the weapons system should be allowed to warm up for 10 to 15 minutes before firing. Upon completion of aircraft run-up, an operational check of the weapons system should be conducted in accordance with paragraph 11-23. After arriving on the firing line, the weapons are harmonized.

Note. The M21 flexible system will not fire if the battery is low (system operates directly off battery power). The flexible sighting station used with the M21 must be locked in the DOWN position before firing (this closes the electrical circuit that allows the weapons to track with the sight).

a. Select a target approximately 700 meters to the front of the firing line. (Harmonization at this range insures a concentration of all trajectories at approximately 50 meters before normal tracer burnout. The normal tactical engagement range of the unit employing the weapon will de-

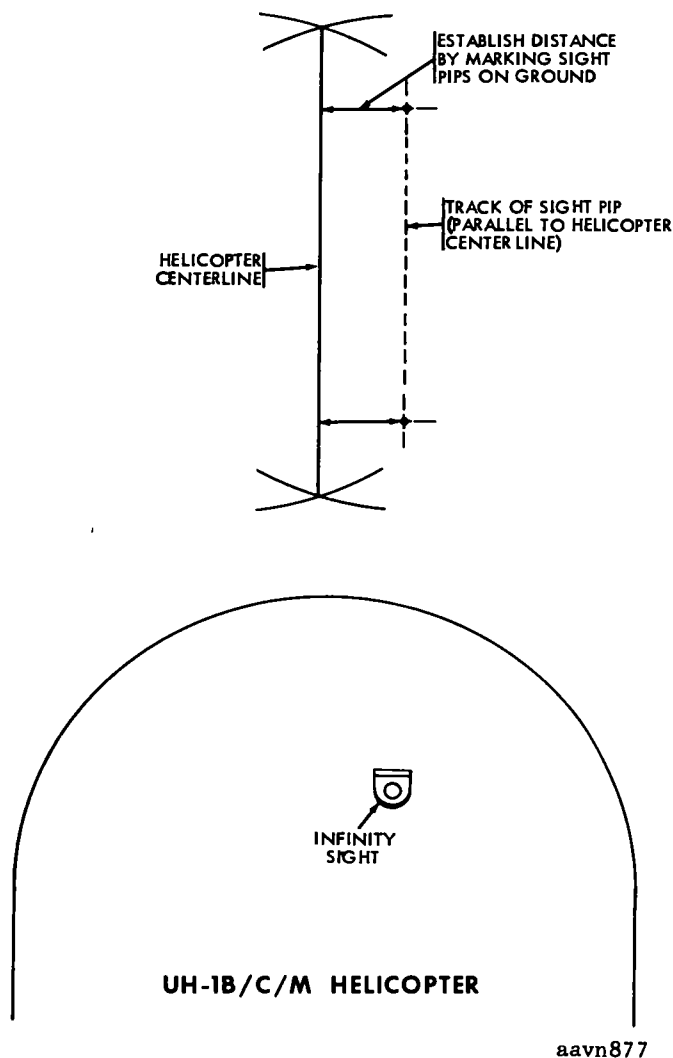


Figure 11-40. Boresighting launchers and infinity sight.

termine the harmonization range. Still another reason for harmonization at this range is that the trajectories crossing at this point create a relatively small area of concentrated fire which eliminates wide dispersion when engaging targets at close range. The small cone of fire created beyond the harmonization point insures close dispersion on targets engaged out to 1,500 meters.)

b. Aline the helicopter on the firing line so that its center line intersects the target as closely as possible. (Harmonizing on a target to the direct front allows the full flexible capability of the weapons on either side of the helicopter to be attained.)

Note. Indicate to the ground crew the exact location of the harmonization target.

c. Have the ground crew personnel load the weapons. For hand and arm signals used in directing ground crew personnel during flexible harmonization, see figure 13-2.

d. If using M21, place gun selector switch to LEFT position.

e. Obtain permission to fire from the range control tower or other controlling agency.

f. Alert the ground crew personnel. Visually check both sides of helicopter.

g. Place the ARMED-SAFE-OFF switch located on the control panel to the ARMED position.

h. Place the toggle switch located on the sighting station to either the fore or aft position to obtain a sight reticle.

i. Depress the actuator bar located on the grip assembly of the optical sight and aline the sight piper on the exact selected aiming point.

j. Stabilize the sight piper on the target and depress the actuator bar. (At this time the ground crew will make the initial muzzle/target alinement with boresight tools.)

Warning: It is important to keep the actuator bar depressed while the ground crew is making adjustments. Failure to do so will result in poor target alinement and possible injury to the ground crewmen.

k. Upon receiving a signal from the ground crew, *smoothly* press the trigger on the grip assembly to fire a short burst (approximately 1 second; length of burst when firing M21 is 1 to 3 seconds). Maintain a constant sight picture throughout this process.

l. Using appropriate hand signals, signal to the ground crew the desired adjustment to move the strike of the bullets to the point on which the piper is oriented.

Note. The pilot may receive these instructions over the aircraft interphone from the gunner and relay them to the ground crew. This allows the gunner to maintain his sight picture throughout the harmonization process.

m. The ground crew will make adjustments to the gun mount assembly as required.

n. Upon signal from ground crew, repeat firing to observe the effects of the adjustment.

o. Repeat fire-adjust-fire process until the left gun is alined properly.

p. Place selector switch in RIGHT position. Release actuator bar relax.

q. To aline the right gun, repeat steps in i through o above.

r. To verify the harmonization of both guns, aline the piper on the aiming point, depress the actuator bar, and fire. Rounds from both guns

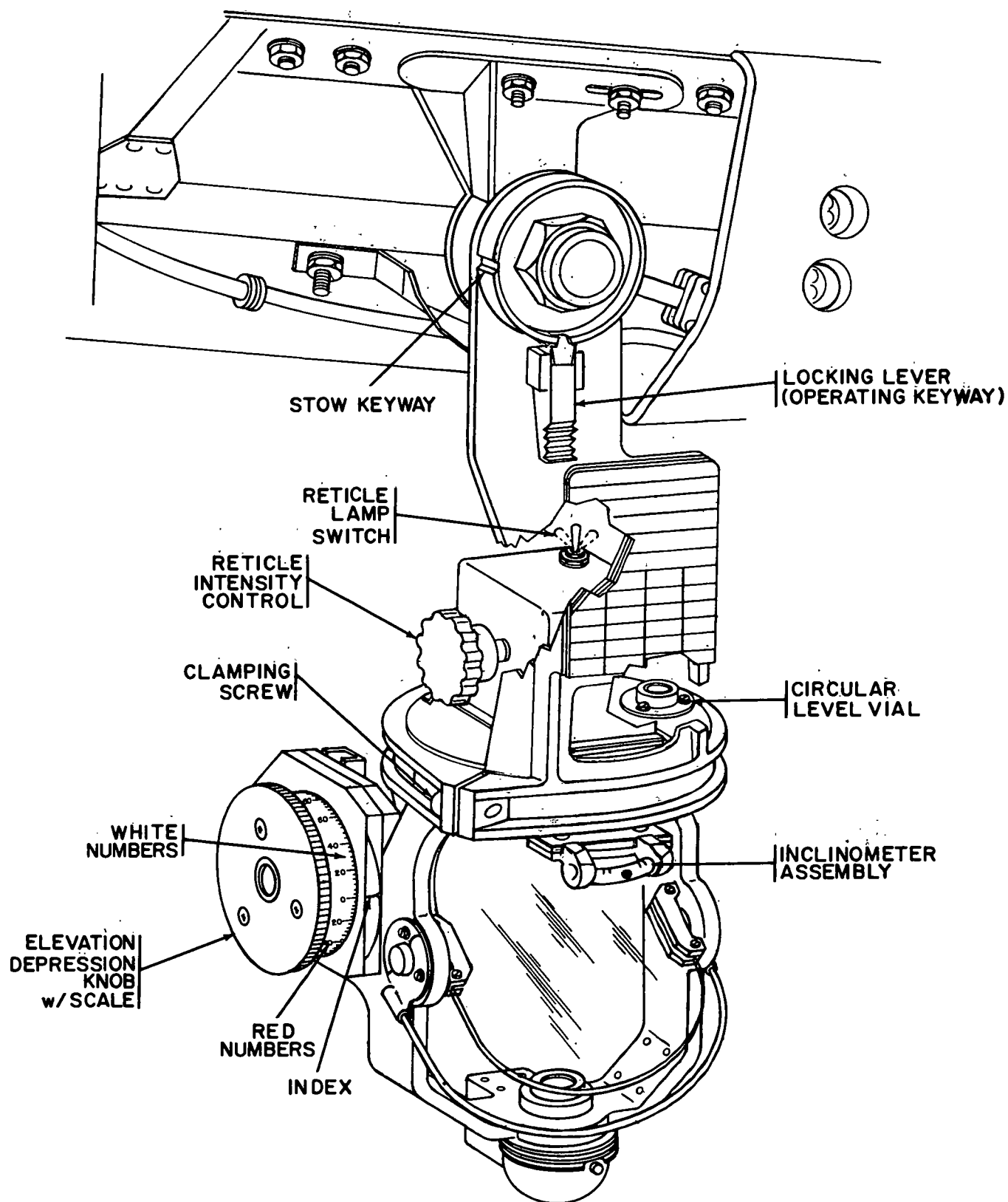
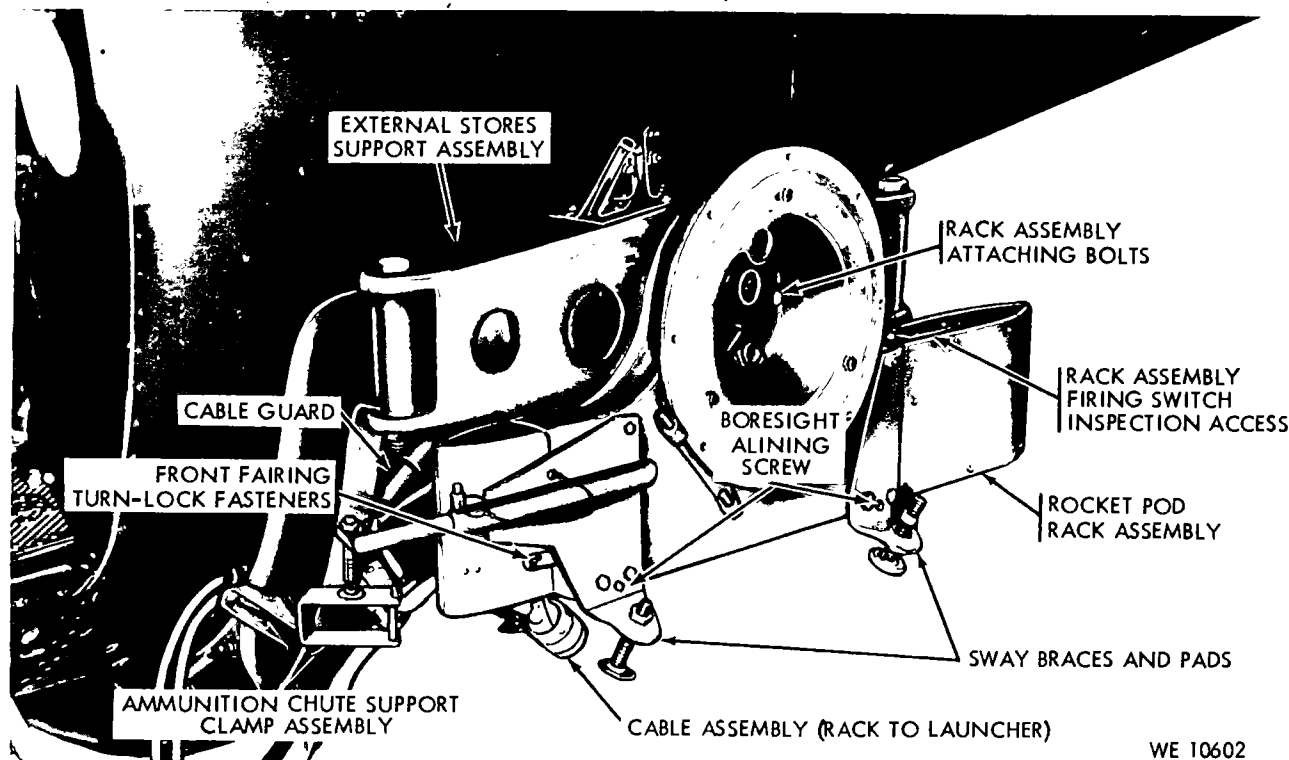


Figure 11-41. XM60E1 infinity sight.



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Figure 11-42. Rack and support assembly installed on external stores support assembly—left side.

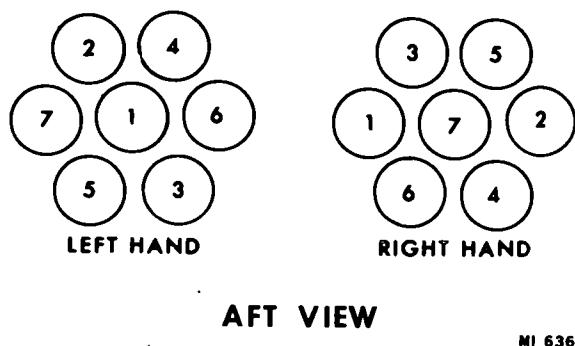


Figure 11-43. Firing sequence for M158A1 series rocket launchers.

should strike the target at the point on which the pippier is oriented.

s. If alinement is not correct, repeat the alinement process to adjust the inaccurate weapon.

t. Place the ARMED-SAFE-OFF switch to the SAFE position.

u. Dismiss the ground crew. At this time, the harmonization is complete.

11-26. Preparation for Loading Ammunition

Note. Procedures apply to both right-hand and left-hand weapons, unless otherwise noted.

a. 2.75-Inch Rocket Launchers.

(1) Stray voltage test.

Note. Be sure that all electrical connectors are secure and power is removed from the launchers.

(a) Set multimeter to the 2.5 volts direct-current range.

(b) Touch the second lead to the igniter head of each tube in sequence.

(c) If a voltage reading is obtained when testing any tube, do not load the rocket launcher. Notify the aircraft maintenance personnel to check the helicopter for the source of the stray voltage.

(2) Firing voltage test. The firing voltage test is performed to insure proper launcher operation and to isolate any tube malfunctions (TM 9-1090-202-12, table 3-3). For firing sequence, see figure 11-43.

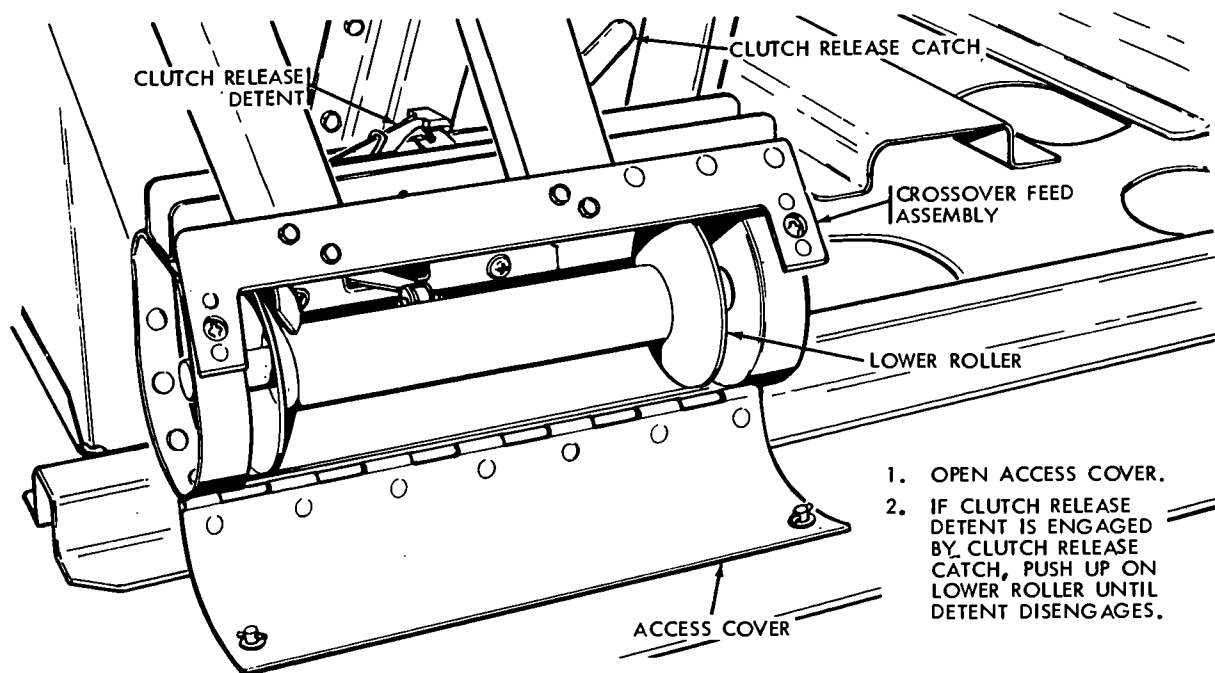
(a) Set the OFF-SAFE-ARMED switch to SAFE.

(b) Intervalometer ROCKET/GUNS switch to 2.75.

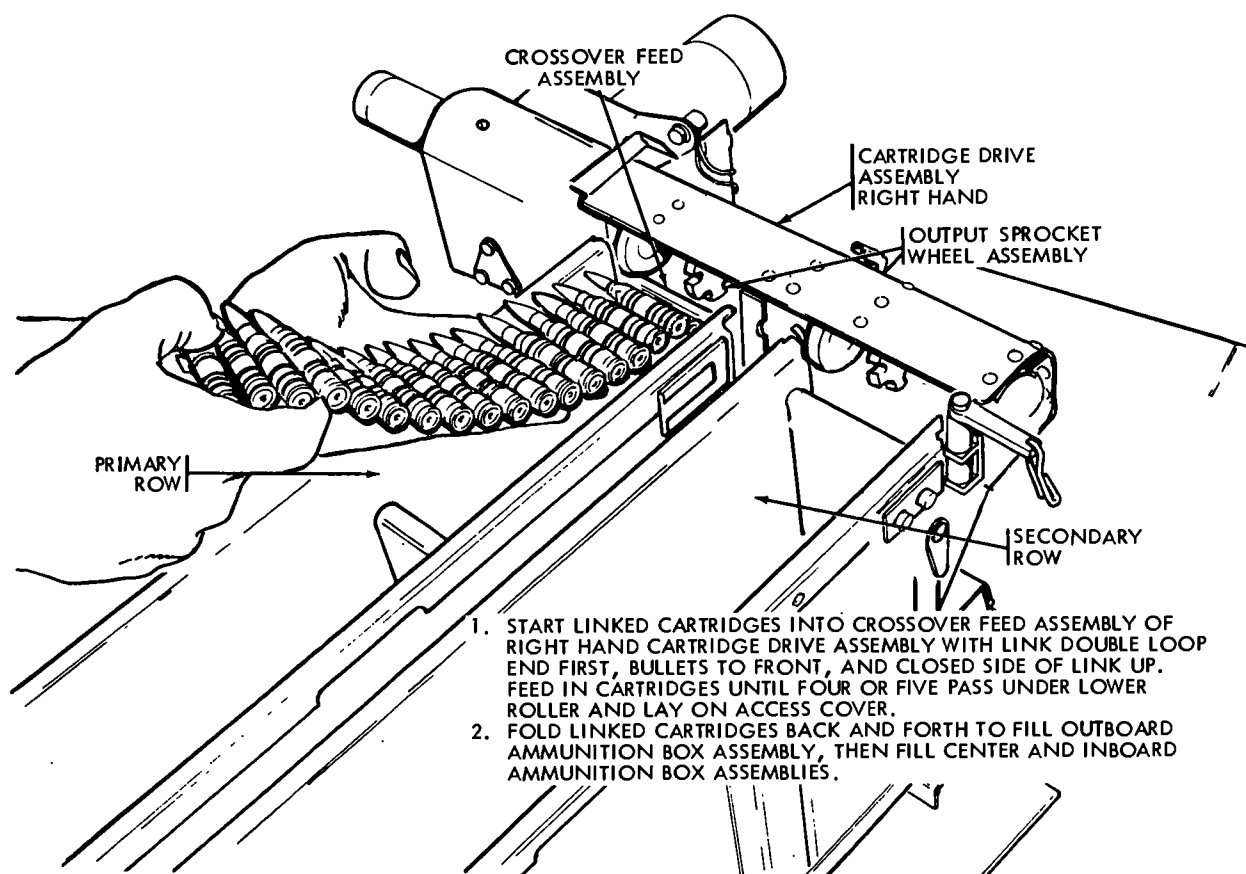
(c) Set RKT PAIR SELECTOR switch to 1.

(d) Energize the firing system.

(e) Depress the intervalometer RKT RESET switch and be sure that rack firing switch is in the reset position.



A - CROSSOVER FEED ASSEMBLY PREPARED FOR CARTRIDGE LOADING.

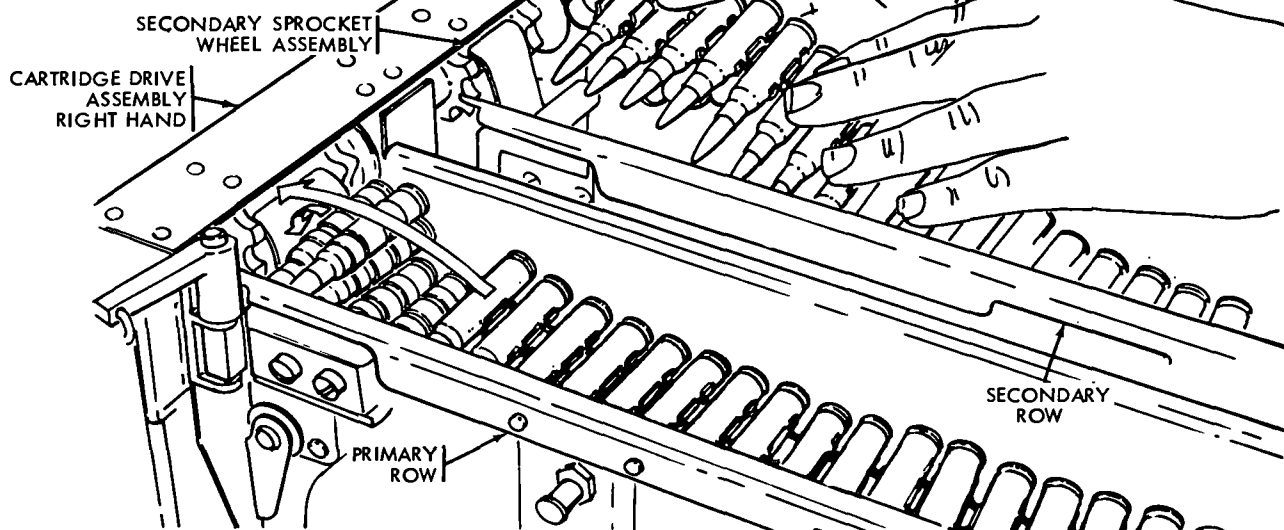


B - LOADING PRIMARY ROW OF AMMUNITION BOX ASSEMBLIES.

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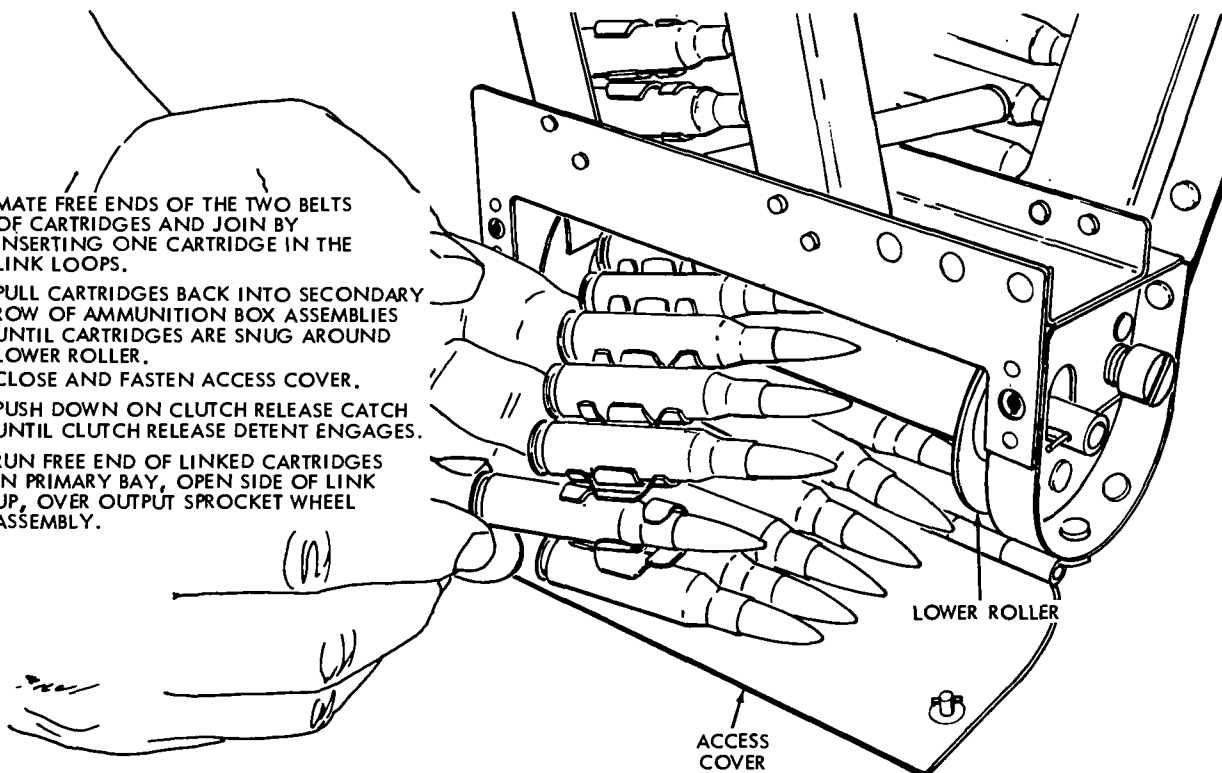
Figure 11-44. Loading 7.62mm ammunition box assemblies and cartridge drive assemblies—right side shown.

1. START LOADING LINKED CARTRIDGES IN OUTBOARD AMMUNITION BOX ASSEMBLY WITH LINK DOUBLE LOOP END FIRST, BULLETS TO FRONT, AND OPEN SIDE OF LINK UP. FOLD BACK AND FORTH TO FILL OUTBOARD, CENTER, AND INBOARD AMMUNITION BOX ASSEMBLIES.
2. RUN REMAINING LINKED CARTRIDGES. OPEN SIDE OF LINK UP, OVER SECONDARY SPROCKET WHEEL ASSEMBLY UNTIL SEVERAL CARTRIDGES ARE IN FRONT OF LOWER ROLLER.



C - LOADING SECONDARY ROW OF AMMUNITION BOX ASSEMBLIES.

1. MATE FREE ENDS OF THE TWO BELTS OF CARTRIDGES AND JOIN BY INSERTING ONE CARTRIDGE IN THE LINK LOOPS.
2. PULL CARTRIDGES BACK INTO SECONDARY ROW OF AMMUNITION BOX ASSEMBLIES UNTIL CARTRIDGES ARE SNUG AROUND LOWER ROLLER.
3. CLOSE AND FASTEN ACCESS COVER.
4. PUSH DOWN ON CLUTCH RELEASE CATCH UNTIL CLUTCH RELEASE DETENT ENGAGES.
5. RUN FREE END OF LINKED CARTRIDGES IN PRIMARY BAY, OPEN SIDE OF LINK UP, OVER OUTPUT SPROCKET WHEEL ASSEMBLY.



D - JOINING LINKED CARTRIDGES FROM PRIMARY AND SECONDARY ROWS OF AMMUNITION BOX ASSEMBLIES.

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(f) Place OFF-SAFE-ARMED switch in ARMED position.

(g) Set the multimeter to 10 milliamps.

(h) Place the negative lead on an unpainted metal surface of the helicopter. Place the positive lead to the igniter head of the tube assembly number 1, and depress the firing switch (trigger) on the cyclic stick. The meter needle should deflect indicating a pulse of firing current.

(i) Continue the procedure in (h) above for tubes 2 through 7.

(3) *Final action.*

(a) Move OFF-SAFE-ARMED switch to OFF position.

(b) Check that all armament circuit breakers are open, external 28 volts direct current power is disconnected, or helicopter battery power switch is in OFF position.

(c) Ground helicopter with a static ground cable.

b. 7.62mm automatic gun assembly.

(1) Check to make sure that procedures of a(3) above are accomplished.

(2) Remove safing sector and housing cover from M134 automatic gun (fig. 11-33).

11-27. Loading or Unloading Ammunition

a. Loading 7.62mm Ammunition.

(1) Make sure that the procedures of paragraphs 11-26a(3) and 11-26b(2) have been performed.

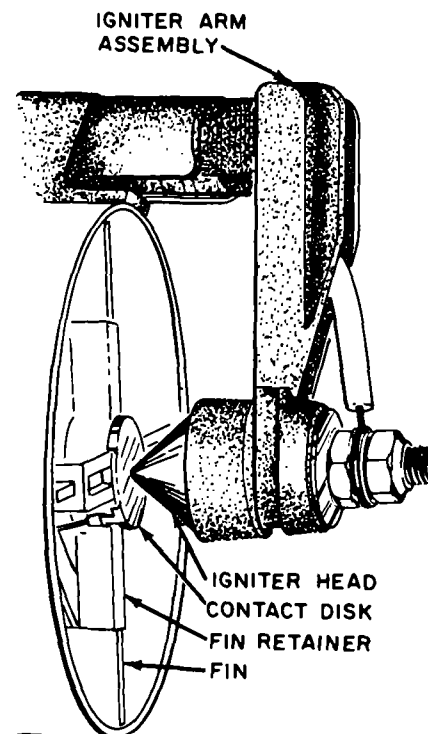
(2) Load ammunition into ammunition box assemblies and cartridge drive assemblies as shown in figure 11-44.

(3) With ammunition chute disconnected from delinking feeder MAU-56/A and cartridge drive assembly, insert linked ammunition through chuting. Mate free ends at the cartridge drive assembly and join by inserting one cartridge in the link loop.

(4) Connect ammunition chute to the output of the cartridge drive assembly and to delinking feeder MAU-56/A. Work ammunition, by applying pressure with the fingers, to the linked ammunition in the chute assembly. Then rotate barrels of M134 automatic gun until delinking feeder MAU-56/A picks up ammunition and ejects at least one or two rounds.

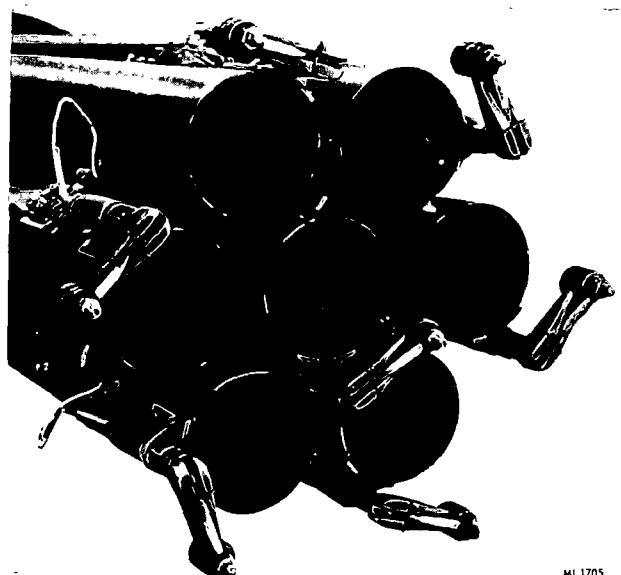
b. Loading 2.75-Inch Rockets. Stand to the side of the launcher when loading or unloading.

Warning: Do not perform any part of loading operation until stray voltage and firing voltage tests have been performed.



MI 1708

Figure 11-45. Igniter arm assembly.



MI 1705

Figure 11-46. Igniter arm assemblies in load/unload position.

(1) Pull outward on each igniter arm assembly (fig 11-45) and swing arm clockwise to the load/unload position (fig 11-46).

Warning: Do not (1) load, store, or handle 2.75-inch rockets near operating radio frequency energy transmitting equipment; (2) stand in front of the launcher; (3) load or unload the launcher from the rear; or (4) use unauthorized

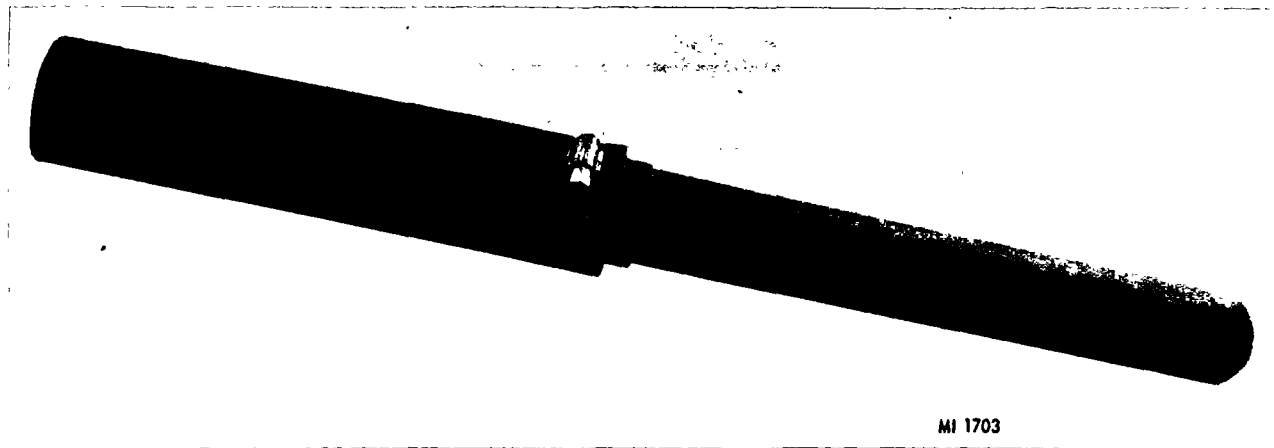
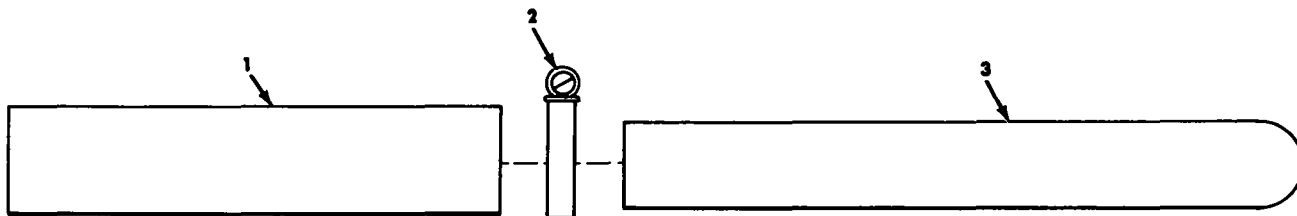


Figure 11-47. Loading tool for rockets armed with M151 warheads.



MI 1704

Figure 11-48. Components of the loading tool.

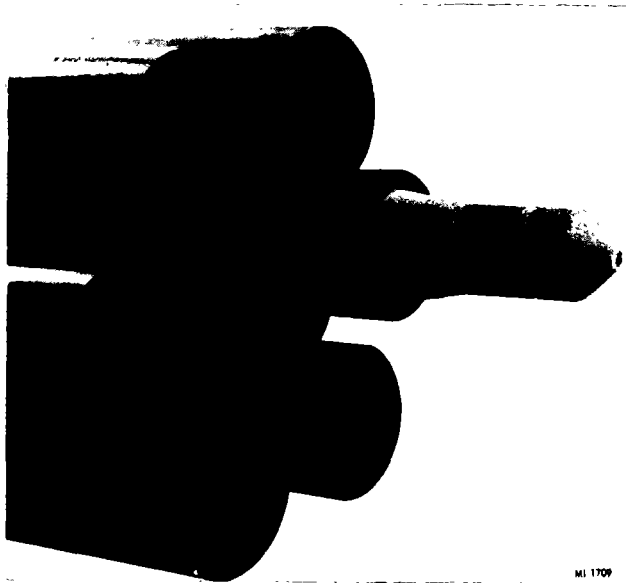


Figure 11-49. Rocket inserted in launch tube.

objects, such as a piece of wood, to assist in loading or unloading the launcher.

(2) Prepare the rocket for firing as directed in TM 9-1340-201. If the rocket is armed with an M229 warhead, proceed to step (4) below.

(3) Prepare a tool (fig 11-47) for loading or unloading rockets armed with M151 warheads as follows:

(a) Cut a 14-inch length of $1\frac{3}{4}$ -inch wooden dowel rod (FSN 5510-492-2856) (3, fig 11-48) and a 10-inch length of radiator hose (FSN 4720-517-7917) that is $1\frac{3}{4}$ inches inside diameter and $2\frac{1}{4}$ inches outside diameter (1, fig 11-48).

(b) Insert one end of the rod 2 inches into the hose, and secure it there with the hose clamp (FSN 4730-720-0973) (2, fig 11-48). The assembled tool should be 22 inches long.

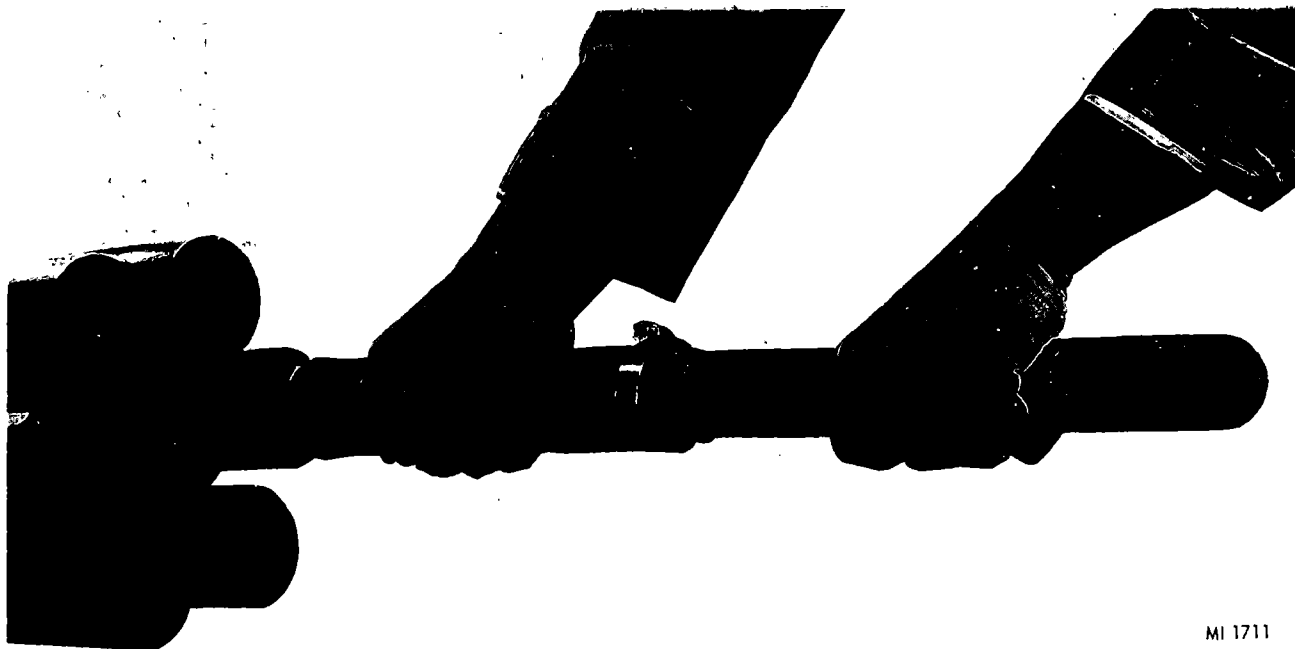
(4) Touch the shorting clip (installed on the nozzle fin assembly) to the launcher to ground out any stray voltage.

(5) Remove the shorting clip and insert the rear of the rocket into the muzzle end of the launcher. If the rocket is armed with an M229 warhead, proceed to step (8) below.

(6) Push the rocket into the tube until only the warhead is left sticking out as shown in figure 11-49.

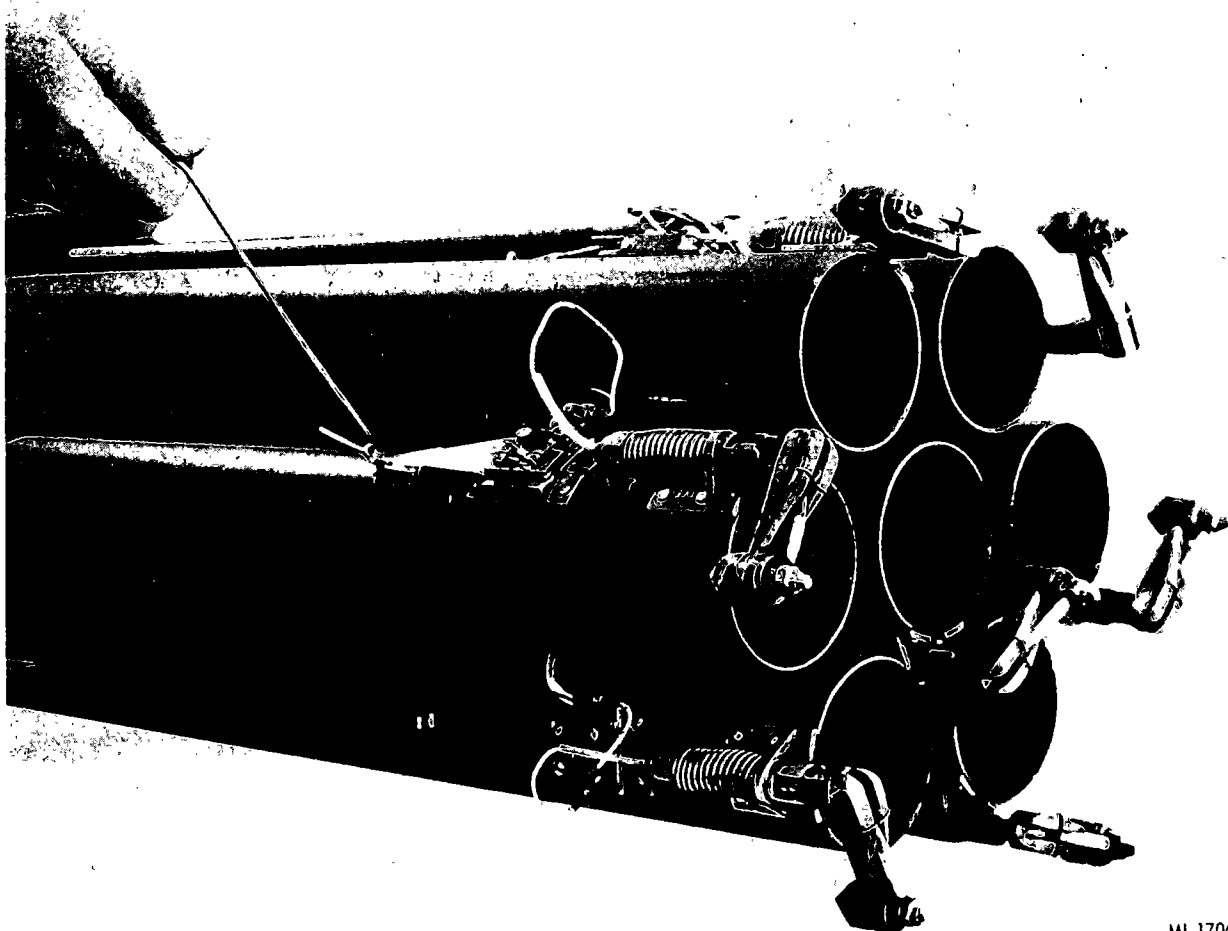
(7) Push the hose end of the loading tool over the rocket fuse until the hose seats against the warhead as shown in figure 11-50.

(8) Gently shove the rocket into the tube until the rocket is stopped by the detent. If the rocket is armed with an M151 warhead, shove with the loading tool.



MI 1711

Figure 11-50. Loading tool installed on the rocket warhead.



MI 1706

Figure 11-51. Lifting the detent with the shorting clip.

(9) Using the shorting clip removed in (5) above, lift the detent as shown in figure 11-51. At the same time, shove the rocket on back until the ends of the fins are flush with the breech end of the launcher.

(10) Release the detent and make sure that it is seated in the retaining groove on the rocket's nozzle fin assembly. If the rocket was one armed with an M151 warhead, remove the loading tool.

(11) Pull outward on the igniter arm assembly and swing it counterclockwise until the head of the assembly is touching the disk portion of the fin retainer (fig 11-45).

c. Unloading 2.75-Inch Rockets.

Warning: Position helicopter so that the weapons are aimed into a clear area. Clear all personnel from the possible firing area.

(1) Perform the following precautionary steps:

(a) Install bullet trap assembly to M134 automatic gun(s), if 7.62mm ammunition has not been unloaded (d below).

(b) Move OFF-SAFE-ARMED switch to OFF position.

(c) Check that all armament circuit breakers are open and external 28 volts direct current

power is disconnected or helicopter battery power switch is in OFF position.

(d) Ground helicopter with a static ground cable.

(2) Pull outward on the igniter arm assembly and swing it clockwise to the load/unload position.

(3) If the rocket is armed with an M151 warhead, push the hose end of the loading tool over the rocket fuse until the hose seats against the warhead.

(4) Using a shorting clip, lift the detent as shown in figure 11-51.

(5) If the rocket is armed with an M151 warhead, draw the rocket forward until its warhead clears the launch tube as shown in figure 11-50, and remove the tool from the rocket.

(6) Remove the rocket from the launcher, install the shorting clip on the rocket's nozzle fin assembly, and prepare the rocket for storage or reuse.

(7) Pull outward on the igniter arm assembly and swing it counterclockwise to its rest (centered) position.

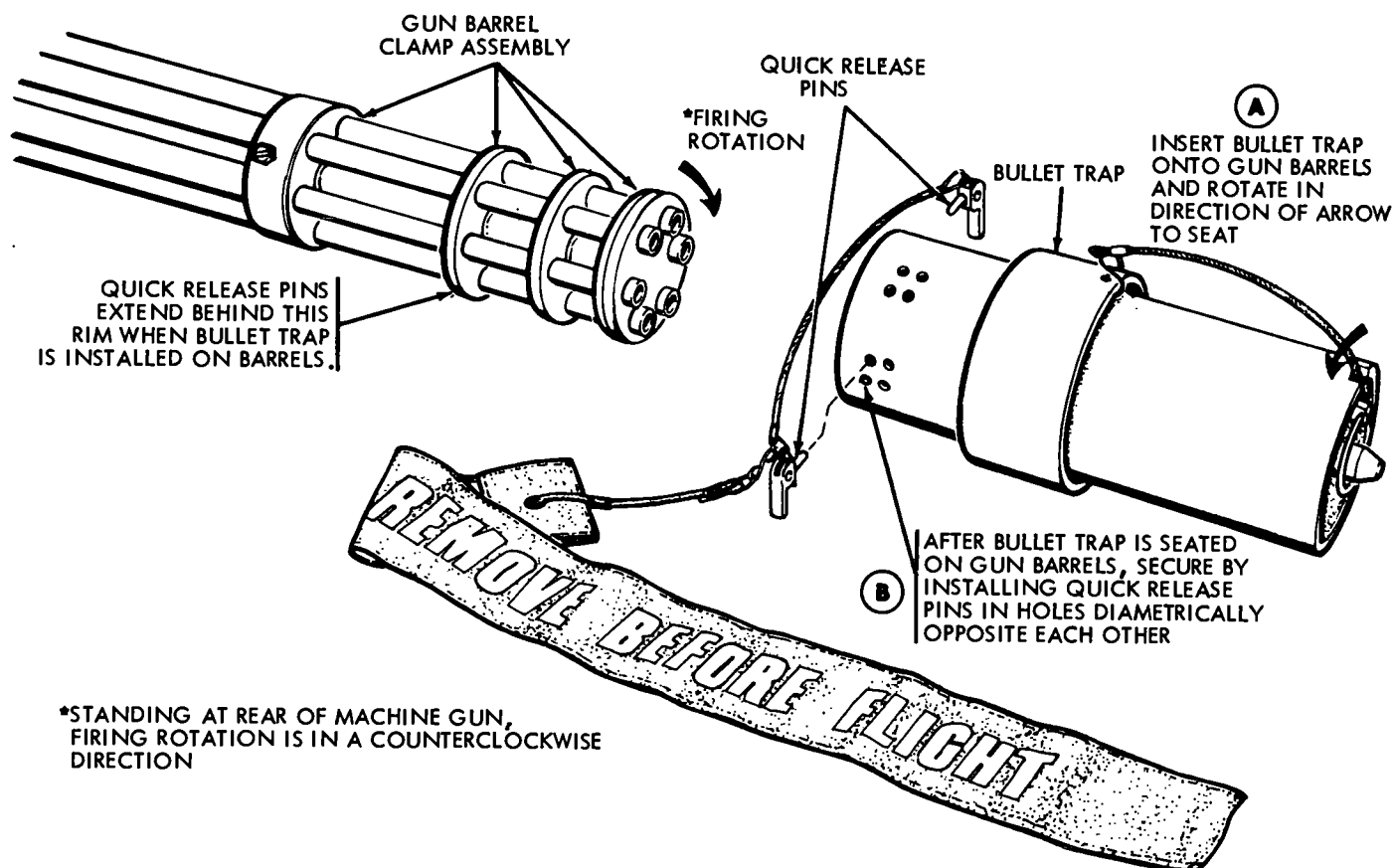


Figure 11-52. Installation/removal of bullet trap.

d. Unloading 7.62mm Ammunition.

Warning: Observe all safety precautions governing the handling of weapons and live ammunition. Weapons shall be pointed in a direction which offers the least exposure to personnel, property, and materiel in the even of accidental firing. The bullet trap assembly is not to be used for test firing or clearing the weapon. It is specifically designed to catch an accidentally fired bullet(s), thereby providing safety to personnel and preventing damage to materiel.

(1) Refer to figure 11-52 and insert bullet trap assembly onto barrel cluster until barrels contact deflector within housing of bullet trap assembly.

(2) Rotate bullet trap assembly in the direction opposite that of gun firing rotation, until barrels seat within recessed area of deflector of bullet trap assembly.

(3) Install the quick release pins of the bullet trap harness assembly into two holes in the bullet trap housing which are diametrically opposite each other and are directly behind the third rib of the automatic gun barrel clamp assembly.

Note. Select diametrically opposite holes in the bullet trap housing, which will keep the end play between automatic gun barrels and the bullet trap assembly to a minimum, when quick release pins are installed. Removal of bullet trap is in reverse order of installation.

Warning: If the bullet trap assembly is not

available for installation ((1) through (3) above), manually turn barrel cluster in direction opposite firing rotation (fig 11-52) before removing safing sector of M134 automatic gun.

(4) Make sure that M21 armament subsystem is prepared for unloading as stated in paragraphs 11-26a(3) and 11-26b(2).

(5) Disconnect ammunition chute from delinking feeder MAU-56/A and remove one cartridge from the linked cartridges.

(6) Manually rotate barrel cluster in firing direction and inspect to see that remaining cartridges clear from delinking feeder MAU-56/A and M134 automatic gun.

(7) Open access door of cartridge drive assembly and manually delink one cartridge.

(8) If required, delink one cartridge from linked cartridges in primary row of ammunition box assemblies just before cartridges pass over output sprocket wheel assembly (B, fig 11-44).

(9) Remove ammunition chute from cartridge drive assembly and pull linked cartridges toward the gun through the output sprocket wheel assembly.

(10) Pull both ends of remaining linked cartridges out of cartridge feed assembly and into their respective ammunition box assemblies.

Section III. M22 ANTITANK GUIDED MISSILE SYSTEM ON UH-1B/C/M HELICOPTERS

11-28. Description and Capabilities

The M22 is a helicopter-mounted missile armament subsystem (fig 11-53). Missiles are fired, controlled, and guided by a gunner in the copilot's seat of the UH-1B/C/M helicopter. The gunner operates an airplane-type control stick to signal the missile in pitch and yaw commands. These directional commands are transmitted to the in-flight missile through two guidance wires which play out from spool assemblies inside the missile. The command impulses are decoded inside the missile and routed to its flight control devices.

a. The M22 armament subsystem installed on the UH-1B/C/M helicopter (fig 11-54) provides frontline troop support with a point-fire weapon capability. Primarily an antitank weapon, it is also effective against gun emplacements, road blocks, fortifications, and similar targets. Responsive and highly mobile, the UH-1B/C/M M22 missile subsystem may be employed with airmobile and ground maneuver elements in the role of aerial point-fire support.

b. The subsystem's six missiles can be fired from any helicopter mode (static, hovering, or in-flight). The firing has no adverse effects upon the helicopter.

c. The missiles can be fired at ranges between 500 and 3,500 meters in forward flight, or between 500 and 2,900 meters in a static or hovering mode.

d. The daily rate of fire is limited only by ammunition resupply and possible time-compliance parts change or maintenance.

e. General data describing the M22 subsystem is given in table 11-5.

11-29. Limitations

The M22 subsystem is vulnerable to all types of air defense fires, including small arms. Following are operational limitations:

a. The helicopter must be exposed to the target from launch to impact since the missile is guided by the gunner's line-of-sight vision.



Figure 11-53. M22 armament subsystem.

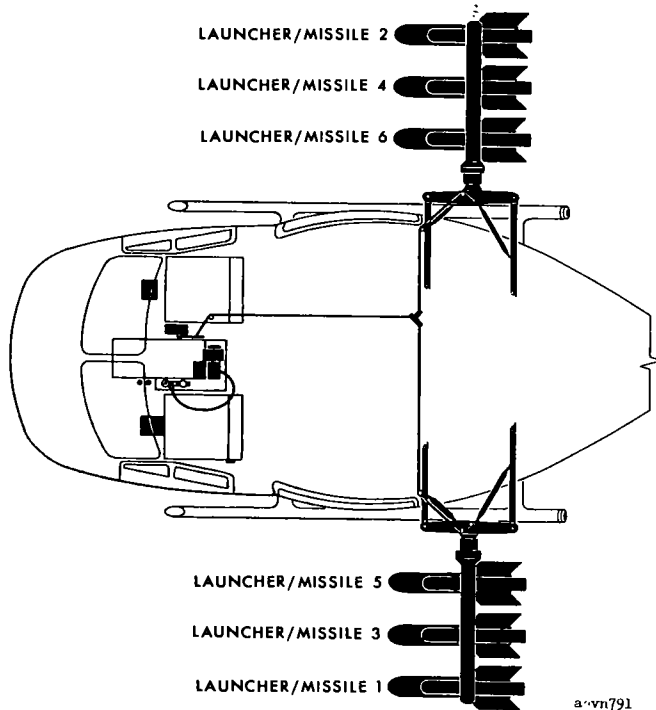


Figure 11-54. Launcher/missile location.

b. Effectiveness is reduced at night and during periods of low visibility (for the reason in *a* above).

c. Use of the M55 binocular sight requires that the helicopter be equipped with yaw stabilization (AN/ASW-12). However, the XM58 sight does not require yaw stabilization.

d. Only one missile can be fired at a time.

11-30. Missile

The missile (fig 11-55) is shipped as a complete round of ammunition in an individual shipping container. The missile's two major components are its warhead and the missile body. See table 11-6 for components data. For proper assembly, installation, and disassembly of the missile, see paragraphs 11-37b and c.

a. *Warhead (A, fig 11-56).* The warhead (1) of the AGM-22B has a 3½-pound shaped charge fixed to it inside the pointed end. For firing, the warhead screws onto the fuze body neck at the front of the missile body. The rear edge of the warhead enters the front end of the missile body (D, fig 11-56) when the missile is completely assembled.

(1) The AGM-22B missile has a 140mm shaped charge HEAT warhead.

Table 11-5. Major Subsystem Components

Item	Length (in.)	Width (in.)	Height (in.)	Diameter (in.)	Weight (lb)	Figure No.
Missile (AGM-22B).....	48	20 (wingspan).....		6½	64	11-55
Housing Assembly.....	8			7	15	11-63
Launcher Support Assembly.....	49			4	15	11-64
Fixed Housing.....	30	4¼.....	4½		6	11-65
Launcher.....	31¾	4¾.....	13½		18½	11-66
Pilot's Sight (including mount).....	18				10	11-67
Gunner's Sight M55 (including mount).....		12	15		18½	11-68
Gunner's Sight XM58 (with control amplifier).....		7	15		50	11-69
Control Stick Assembly.....	8¼	4¾.....	8¼	3¼	3	11-70
Guidance Control Unit T10K3.....	12¼	5½.....	7¾	4	16	11-74
Selection Box.....	10	5.....	4½		10	11-75
Complete Subsystem (w/six missiles installed).....					667	11-54

Table 11-6. Missile Components

Item	Length (in.)	Diameter (in.)	Weight (lb)	Material	Figure No.
Warhead.....	16	6.5	17.5		11-56, at A①
Missile Body.....	32	6.5	46.5	Magnesium casting.....	11-56, at A-D
Battery Holders.....				Stamped steel.....	11-56, at D
Fuze Detonator Assembly.....				Duralumin.....	11-57
Booster Motor and Exhaust Nozzles.....					11-56, at C-D
Sustainer Motor and Exhaust Tubes.....					11-56, at A, D
Decoder.....					11-56, at B
Gyroscopic Distributor.....					11-58, 11-59
Deflector Assembly.....				Molybdenum arm.....	11-56, at C; 11-60
Wing Assembly.....				Aluminum skin Balsa wood filler.	11-56, at B
Spool Assemblies.....					11-56, A, C
Junction Box.....					11-56, at A, C
Batteries.....					11-61
Rear Cover and Tracer Flares.....					11-56, at C
Mounting Lugs.....				Steel.....	11-56, at C
Missile Circuit Test Socket.....					11-56, at A

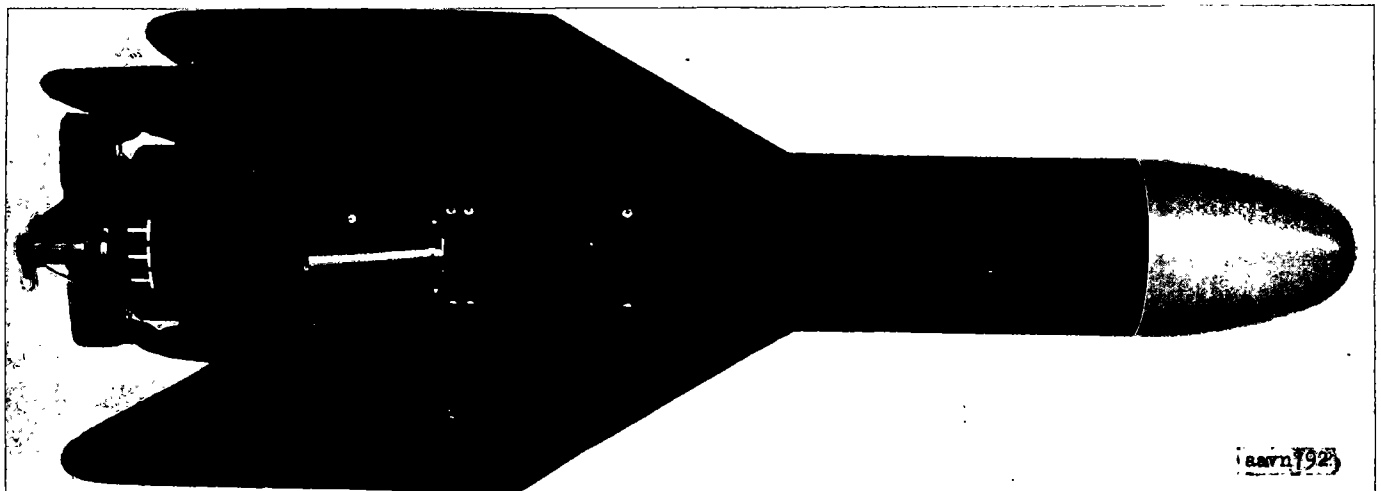


Figure 11-55. M22 missile.

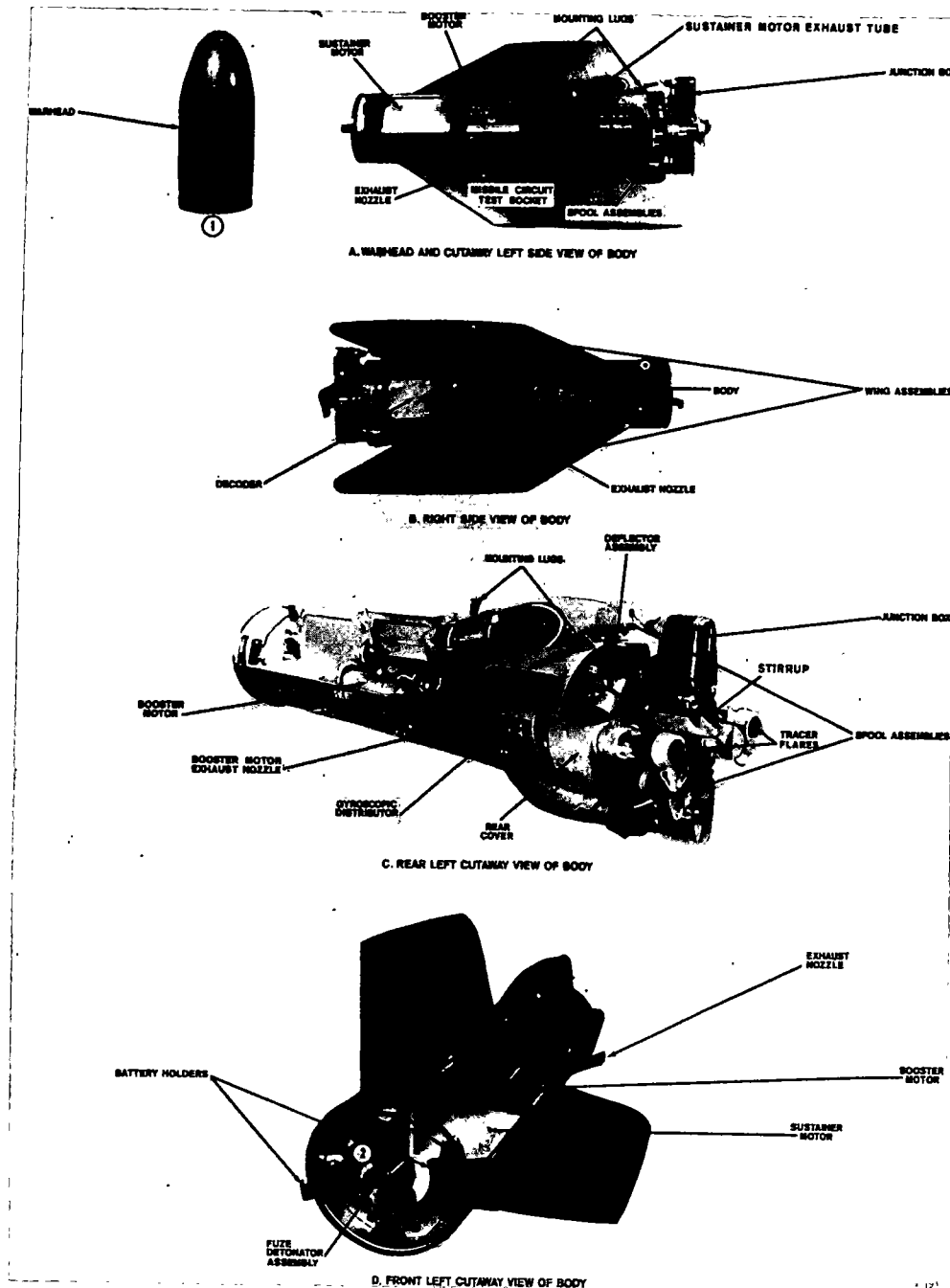


Figure 11-56. Missile components.

(2) The ATM-22B training missile has an inert warhead. It contains a red, nonexplosive marking powder as well as the weights needed for ballast.

Caution: Although alike except for color coding, the warheads cannot be interchanged on AGM and ATM missiles. The tactical round has a fuze and detonator in the missile body, but the training round does not have a detonator.

b. Missile Body (fig 11-56).

(1) The missile body houses—

- Battery holders
- Fuze detonator assembly
- Sustainer motor and exhaust nozzle
- Booster motor and exhaust nozzles
- Decoder
- Gyroscopic distributor
- Deflector assembly

(2) The body also provides the mounting surface for—

- Wing assemblies
- Spool assemblies
- Junction box
- Two batteries
- Rear cover and tracer flares
- Mounting lugs
- Missile circuit test socket

c. Battery Holders (D, fig 11-56). The two battery holders are steel rings secured to the front of the fuze body by four screws each. The individual holder has two battery plugs, each having two guide pins similar to telephone jacks, and four blades that enter the battery sockets and connect them in series to the electromagnet circuit. Each battery, when installed, is held in position by a stainless steel leaf spring. These springs, by lapping out of the missile body when empty, keep the warhead from being screwed on before the batteries are installed.

d. Fuze Detonator Assembly (D, fig 11-56). The fuze* is screwed into the front end of the sustainer motor chamber. It is cylindrical and contains a weighted spring-loaded firing pin. This firing pin is locked in unarmed position by a shear pin (A, fig 11-57). The detonator** is screwed into a central mounting hole in front of the fuze body. Arming (para 11-33f) makes a red piston stick out from the fuze body (B, fig 11-57).

Warning: Before handling the missile body, see if the red plastic piston is protruding. If it is, keep hands off, evacuate the area, and call for explosive ordnance disposal personnel.

e. Booster Motor and Exhaust Nozzles (A, C, and D, fig 11-56). The booster has seven cylindrical blocks of solid propellant that are glued to a spring grid at the front and held by a fixed grid at the rear. A ring-shaped igniter casing with 36 grams of black powder and two igniter filaments are attached to the rear grid. The propellant burns overall on outside surfaces except at the front face (where slowed by an inhibitor).

(1) The booster motor chamber opens into two lateral exhaust nozzles spaced 180° apart in the rear of the motor casing and 90° to the igniter lead-ins.

(2) Each exhaust nozzle axis is inclined 18° to the long axis of the missile, and each nozzle is sealed by a celluloid pellet to protect the motor from moisture.

f. Sustainer Motor and Exhaust Tubes (A and D, fig 11-56). The sustainer motor has a single cylindrical block of solid propellant that burns evenly on the rear surface; an inhibitor has been applied to the front and outside surfaces of the propellant. The rear surface of the propellant has concentric grooves. These grooves hold three ring-shaped ignition casings that contain 1.2 grams of black powder.

(1) Three tubes are molded into the motor 120° apart. Opening toward the front of the chamber, the tubes supply the fuze with the exhaust gases that arm it (fig 11-57).

(2) The rear of the motor is covered by a chamber head from which the centerline exhaust tube protrudes. This tube goes from the sustainer motor through the booster motor to the nozzle outlet (the inside end of which is also plugged by a moisture-guarding pellet).

g. Decoder (B, fig 11-56). The decoder has a printed circuit, 12 transistors, eight diodes, and various resistors and capacitors. Mounted on two supports with four shock absorbers, the decoder has electrical connections to the two spool assemblies, the two missile batteries, and the gyroscopic distributor.

h. Gyroscopic Distributor (C, fig 11-56). The gyroscopic distributor is mounted beside the decoder on its own support plate. It has a gyroscope rotor (in a frame pivoted on the missile roll axis) and a commutator assembly with wipers. The gyroscopic distributor is sealed in a cocoon-like casing to protect it from moisture and dust.

(1) The rotor contains a powder charge and an igniter filament. Its cylinder is pierced with two tangent nozzles at opposite sides. The igniter filament wires pass through one of these nozzles.

*Type 20 P45 C1

**Type 6 PS 35

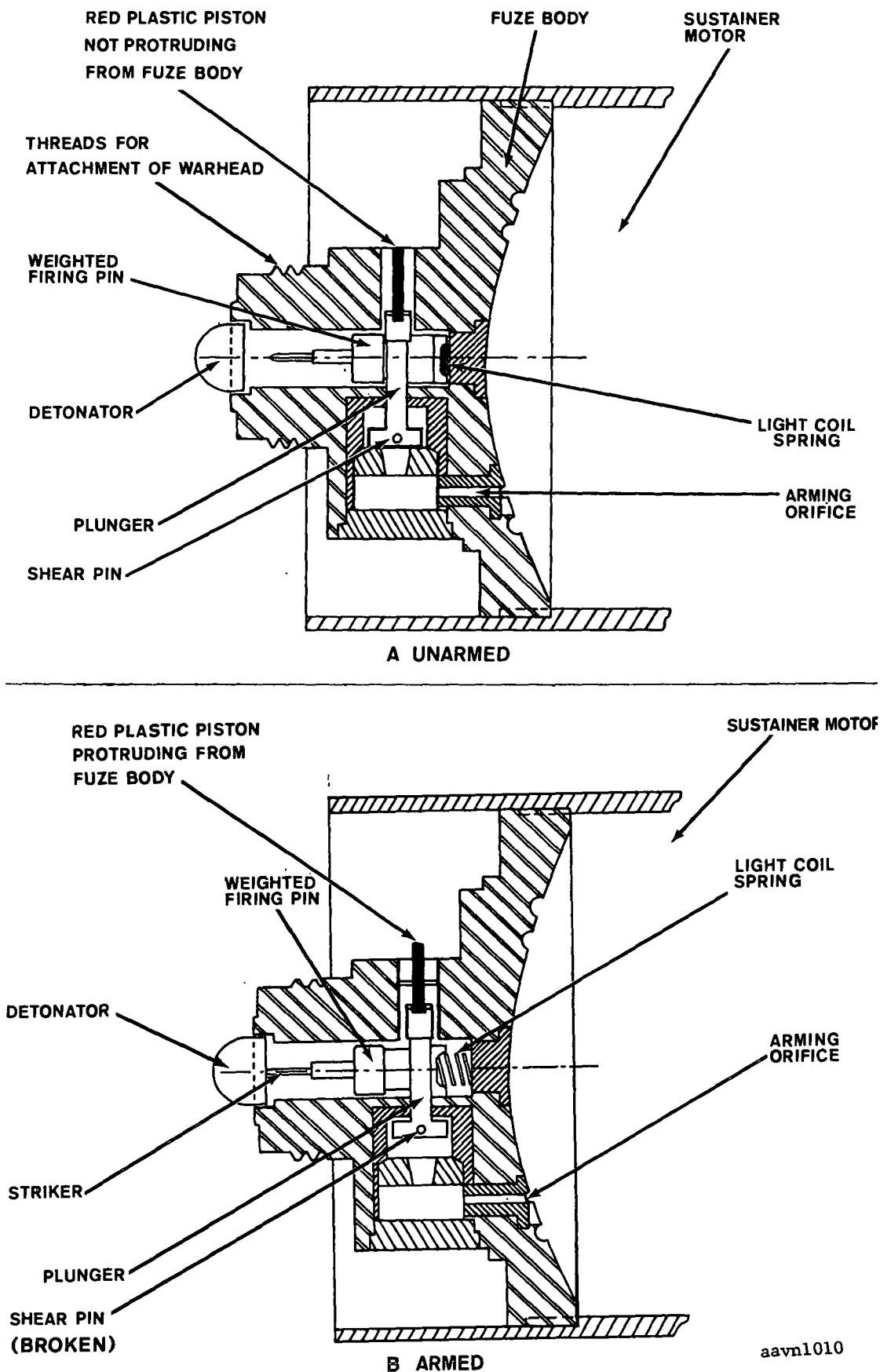
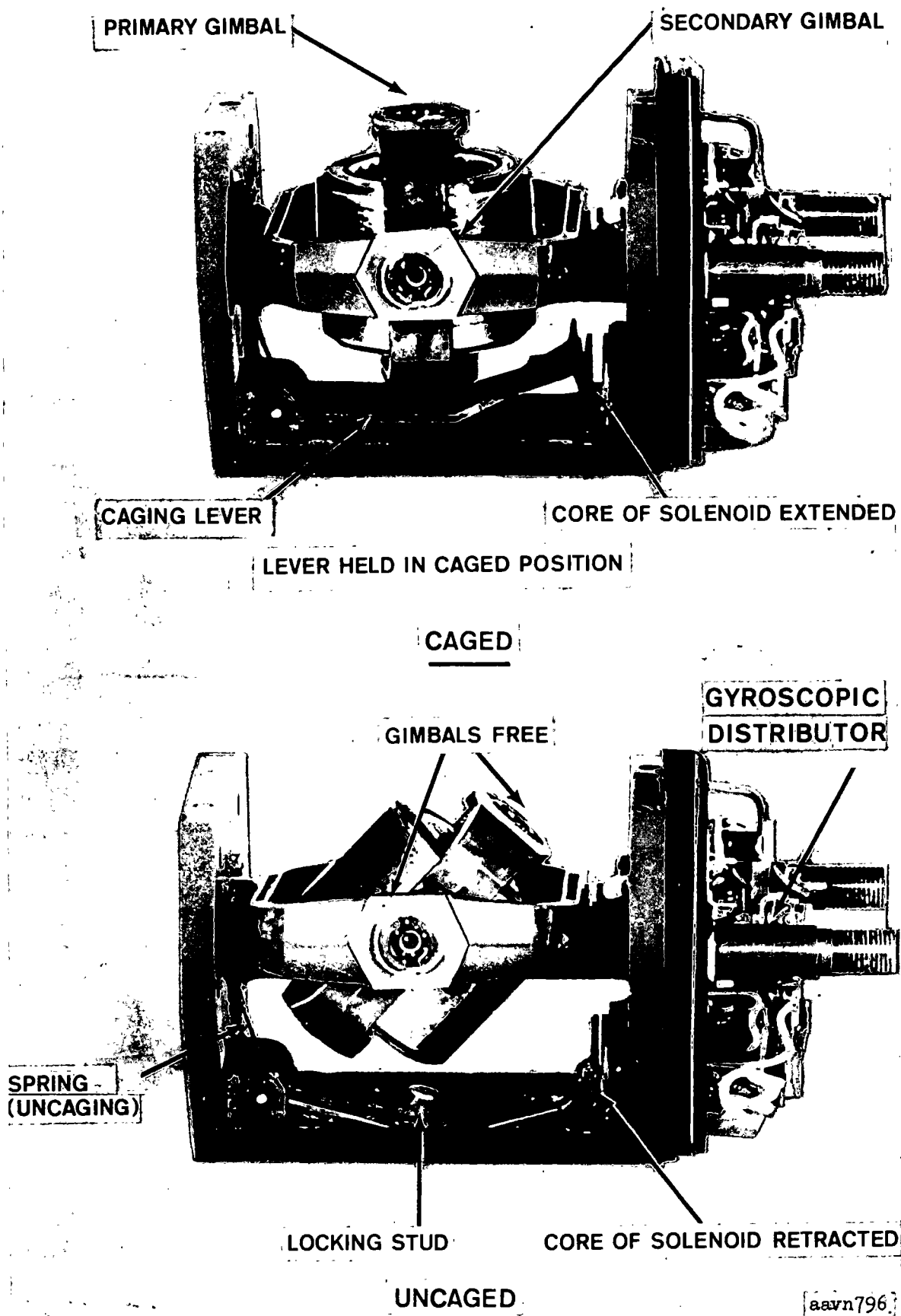


Figure 11-57. Fuze detonator assembly.



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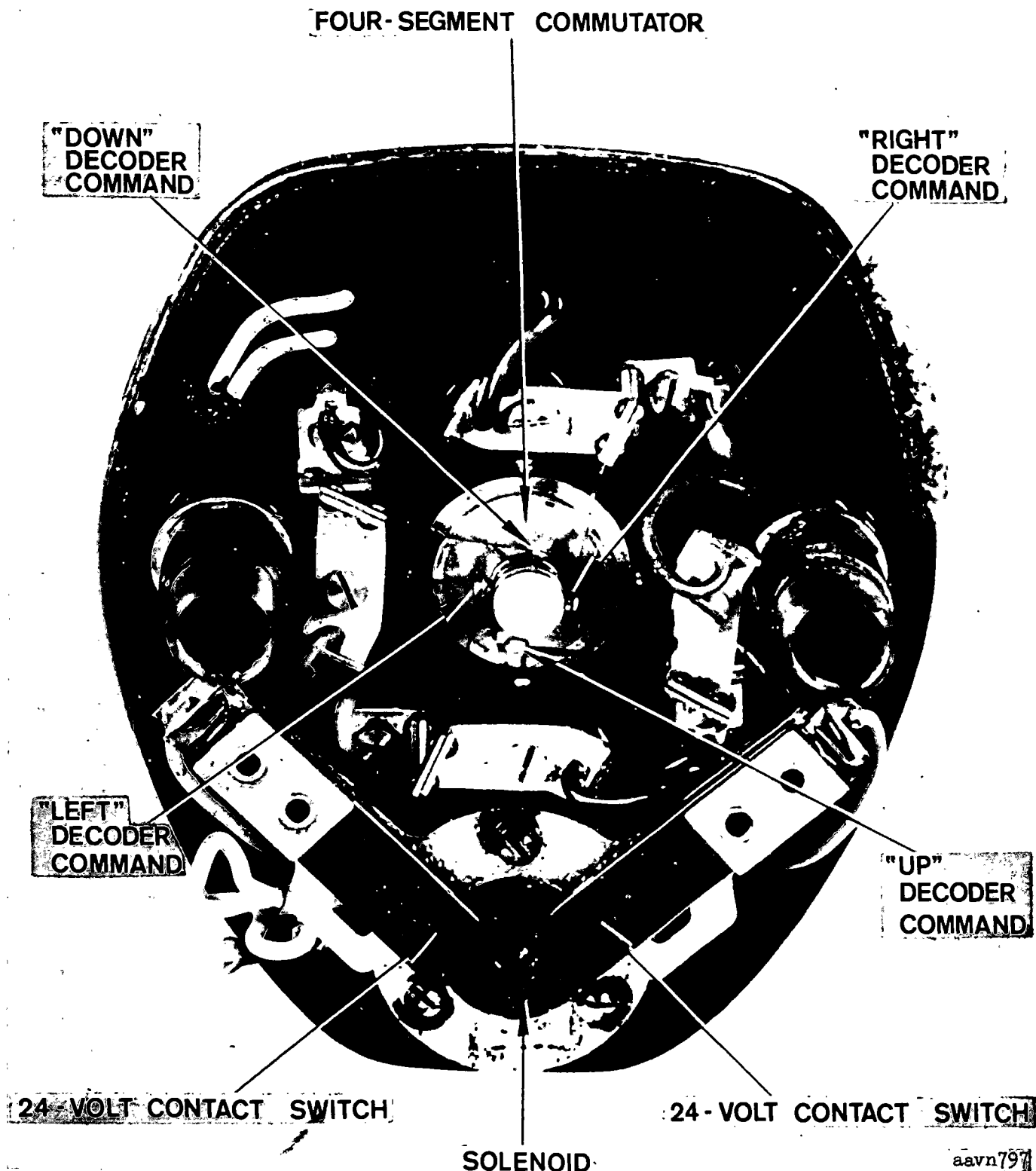


Figure 11-59. Gyrosopic distributor.

(2) The gyroscope is caged by a spring lever bearing a stud which holds the gyro in position when at rest. The lever is held in place by a solenoid armature (fig 11-58). The opposite end of the armature operates a double pole switch which controls the battery circuit.

(3) The commutator has four slip rings with

four brushes connected to the decoder (fig 11-59). Four wipers of the jetavator electromagnets (*i* below) brush the four-segment commutator.

i. Deflector Assembly (C, fig 11-56 and fig 11-60). This assembly (commonly called *jetavators*) has four jet deflectors, each controlled by two electromagnets with a common blade. Each

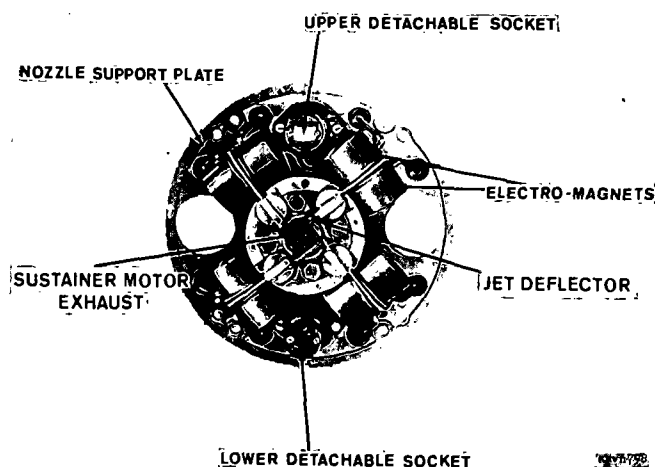


Figure 11-60. Jet deflector assembly.

deflector has a specially shaped arm. The heat-resistant arm may be completely outside, or it may be partially inserted into the jet cross-section at the sustainer motor exhaust outlet. When so inserted, the arm deflects the exhaust gasses and provides missile control. The deflectors vibrate in and out of the exhaust at a frequency in time with the roll rate of the missile. The vibration is caused by the insulation between segments of the commutator (*h(3)* above).

j. Wing Assemblies (B, fig 11-56). The missile has four opposed wings, each having a rounded leading edge and a tapered trailing edge. The wings are attached to the missile body by mounting flanges. Each missile is dynamically balanced at the factory by means of lead balance weights in the small recesses at the forward edge of each wing. The wings are set at an angle of 48 minutes to the long axis of the missile, which causes it to

spin in flight. The spin rate is 3 to $3\frac{5}{8}$ revolutions per second.

k. Spool Assemblies (A, C, fig 11-56). There are two spool housings in recesses on the top and bottom of the missile body. Each contains a spool of enameled steel wire (0.18 to 0.29mm in diameter), 3,300 meters long. The spools are handwound with naval windings (as on a fishing reel). The base of the spool is mounted at the forward end. The rear of the spool housing is machined in the shape of a radiator to reduce the heat from wire friction during its unwinding. The guidance wire leading to the junction box goes through a hole in the rear end also.

(1) One end of each guidance wire is connected to the decoder. The other end, protected with a rubber cap, is connected to a tip jack in the junction box.

(2) Enamel insulation on the wires prevents electrical short circuits when the missile spins (and the wires twist) in flight. The insulation also permits flight over water.

l. Junction Box (A, C, fig 11-56). The junction box, though shipped as a part of the missile, remains locked to the launcher (para 11-31e) after the missile has been launched.

(1) The front face of the junction box has two curved locator plates and two missile connector plugs. The plates fit around the sustainer nozzle. The plugs (four-pin) fit detachable sockets. Each plug is mounted loosely on the box, being held to the socket by a spring on the bevel of the socket sleeve of the missile's rear cover.

(2) The two ends of the guidance wires from

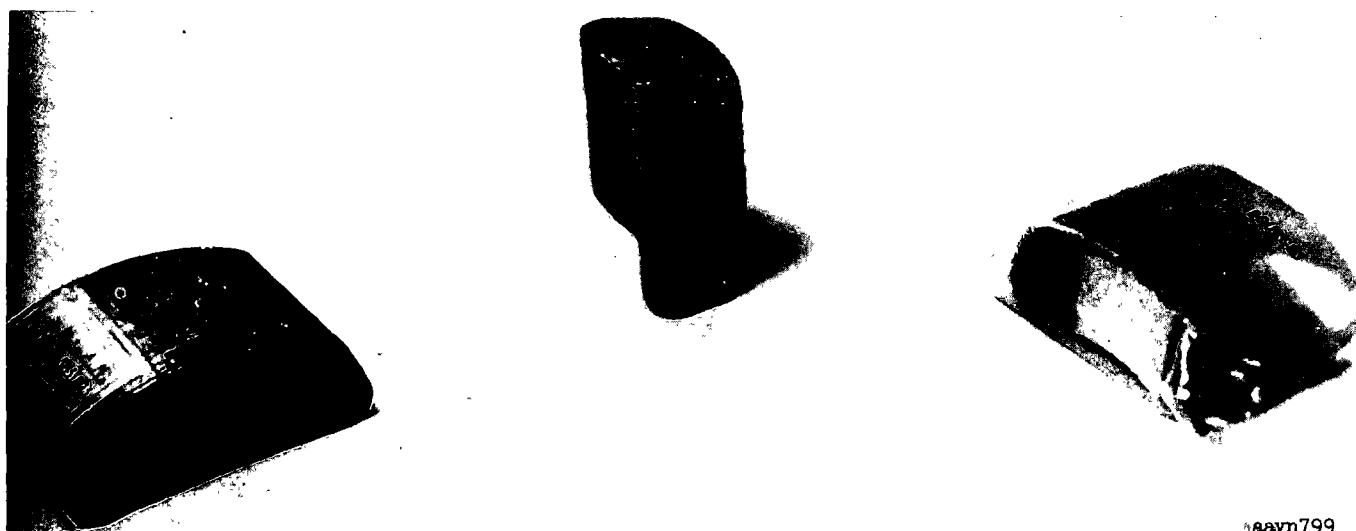


Figure 11-61. Missile batteries.

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the spool assemblies are connected to tip jacks within sleeves. One sleeve is at the top end of the junction box and the other at the bottom end. Each sleeve contains a small explosive charge and igniter to jettison the wire ends after missile impact.

(3) On the sides of the junction box are rubber grommets and a steel stirrup. The grommets are for tracer flare igniter wires. The stirrup permits the junction box to be attached to the launcher (para 11-31e(4)).

(4) The junction box plastic rear cover is rectangular and has tapered round ends. This cover has a seven-pin connector for electrical mating to a plug on the launcher. The connector, mounted internally on a connection box, contains a printed circuit with 10-ohm resistors for the motor ignition circuit, tracers, and detachable connector sockets.

Note. Except for the resistors, igniter wires could fuze together during explosive detonation and cause a short circuit. Since a short circuit draws maximum voltage, the short would burn up the missile circuits. The resistors are safety devices to prevent this.

m. Missile Batteries (fig 11-61). The power for missile guidance comes from two batteries, connected in series, each supplying at least 12 volts. These batteries are plugged in at the battery holder. A strip of tape around each battery (removed before test and assembly) protects the connections from moisture and other foreign matter. Two types of batteries may be used, as described below.

(1) *CIPEL batteries.* Each CIPEL battery has nine cells of 1.5 volts each. All cells are enclosed in a molded plastic case which is waterproof and olive drab in color.

(2) *SANTIS batteries.* These batteries (procured in limited quantity) are similar in appearance to the CIPEL batteries, but differ in color. They are cold storage batteries ($0^{\circ} \pm 5^{\circ} \text{C.}$) which must be used within 90 days from the date raised to normal temperature.

n. Rear Cover and Tracer Flares (C, fig 11-56). The rear cover fits over the rear casing that holds the deflector assembly.

(1) This cover includes mounting ears and collars for the two tracer flares. The flares (two sealed metal tubes) contain a fusing powder that has a combustion time of 21 seconds (minimum) at $+50^{\circ} \text{C.}$ and 23 seconds at -30°C. In other words, flare duration is slightly greater than the greatest missile flight time at similar temperatures.

(2) Each flare has two electrical igniters. These are connected in parallel on a plastic and metal plug that closes the rear end of the flare. The plug, having a mobile pin socket connected to the missile junction box, is ejected immediately after tracer ignition.

(3) The cover also holds two four-pin connectors to the junction box. They provide the final circuitry into the missile.

o. Mounting Lugs (C, fig 11-56). The missile has four mounting lugs, two on the top and two on the bottom. Helicopter-mounted launchers use only the two top lugs. Each lug has two ears that slide in guide rails on the launcher. (The ears on the forward lug are wider and higher than those on the rear lug.)

p. Missile Circuit Test Socket (A, fig. 11-56). The missile circuit test socket is located just below the left exhaust nozzle of the booster motor. It has two metal contacts, one connected to the missile battery positive pole and the other to the decoder. The test socket is protected by a threaded plastic plug that has to be removed. To use the test socket, the plug is removed and a screwdriver or knife blade is inserted between the socket contacts. This completes the circuit to the decoder, applies power to the jet deflector assembly, and results in audible clicks of the jetavators against the electromagnets. (This clicking noise is a down and right command given by the decoder after input of a zero command signal.) This action by the operator tells him that the batteries are properly seated and that the missile circuit is operating properly, even before the gyro locking lever connects battery power to the circuit.

11-31. External Subsystem Components

M22 armament subsystem components mounted externally on the helicopter transport the missiles. These components are light in weight and simple in construction, using an external stores assembly which is compatible with other armament subsystems. For proper assembly and disassembly of external components, see TM 9-1400-461-20. For weights and dimensions, see table 11-7.

Table 11-7. *Weights and Dimensions of External Components*

Item	Length (in.)	Width (in.)	Height (in.)	Diameter (in.)	Weight (lb)
Cable.....	54 1/2	-----	-----	-----	3 1/2
Housing Assembly.....	8	-----	-----	7	11
Launcher Support Assembly	49	-----	-----	4	15
Fixed Housing.....	30	4 1/4	4 1/2	-----	6
Launcher.....	31 3/4	4 3/4	13 1/2	-----	18 1/2

a. Cable Assembly (fig 11-62). The cable assembly on each side of the UH-1 has a 37-pin connector (1) at one end, a 29-pin quick-disconnect (2) at the other, and a threaded collar (3). The connector mates to the external electric socket below the rear doorsill of the helicopter. The quick-disconnect is spring-loaded. When the cable is threaded through the rear access panel of the housing assembly, the quick-disconnect is mated to the fixed electrical socket inside the launcher support assembly. The threaded collar of the cable permits drawing the cable tight between the helicopter and the housing assembly. This restricts the amount of cable outside the housing assembly and also prevents cable slippage after installation.

b. Housing Assembly (fig 11-63). A housing assembly on each side of the helicopter adapts the external stores assembly to the M22 armament subsystem and lets the pilot mechanically jettison the external portion of the system if necessary. One end of the housing assembly has holes for eight mounting bolts which secure it to the cross-beam of the external stores assembly.

(1) On top of the housing assembly are two one-hole lugs; these lugs are spaced for another one-hole lug from the launcher support assembly. When all these lugs are aligned in position, a pin can be temporarily inserted to lock the housing assembly to the launcher support assembly.

Caution: This locking pin must be removed before subsystem use.

(2) Adjustment of the nut and latch on the rear side of the housing assembly assures a snug mating of the launcher support and housing assemblies.

(3) Mounted inside the housing assembly is—

(a) A jettison hook, which mechanically mates with a roll bar inside the launcher support assembly (c below).

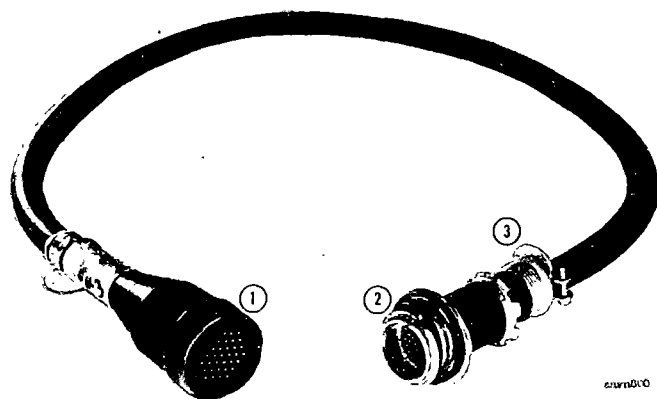


Figure 11-62. Cable assembly.

(b) An electrical quick-disconnect, which is a part of the cable assembly (a above):

c. Launcher Support Assembly (fig 11-64). The launcher support assembly on each side of the helicopter is a hollow metal tube. Its flared in-board end contains a roll bar for the mechanical jettison hook (b(3)(a) above) and a 29-pin socket which mates with the cable assembly quick-disconnect (a above) inside the housing assembly. An internal wiring harness leads from the quick-disconnect plug to two cables. These cables extend through the three holes in the tube at each of the three fixed housing assembly mounting stations—one cable has a three-pin connector for the explosive bolt circuit and one cable has a sever-pin connector for the missile circuit.

d. Fixed Housings (fig 11-65). Each of the two launcher support assemblies has three fixed housings that support the launchers.

(1) Each fixed housing is secured to its launcher support assembly by two U-bolts. Setting the elevation angle of the fixed housing determines initial elevation angle of the missile's flight-path. For a detailed description of the gunner's procedure in setting the elevation angle of the fixed housing and launcher, see TM 9-1400-461-20.

(2) Between the two U-bolts, the fixed housing has an access hole for the two cables (C) from the launcher support assembly. A hinged cover on top of the housing (A) provides access to these connections and to the deep well mount (C) for the explosive bolt.

(3) On the bottom of each fixed housing (B), there is a 15-pin electrical connector for the launcher. (Only seven of the 15 pins are used.)

e. Launcher (fig 11-66). Each of the six launchers is fastened to a fixed housing assembly by an explosive bolt (d(2) above). This bolt is mounted in the fixed housing and protrudes through a hole in the launcher.

(1) *Locking lever and hook.* While the helicopter is in flight, a spring-loaded hook on the forward end of the launcher locks the missile in place. During loading operations, the locking lever is used to actuate the hook. (See the locking lever on the side of the launcher (fig 11-66).)

(2) *Explosive cartridge.* The explosive cartridge holds the locking hook in place. A receptacle with a female plug for the cartridge is located just forward of the locking lever.

(3) *Microswitch.* When the locking hook is released, it depresses a microswitch which com-

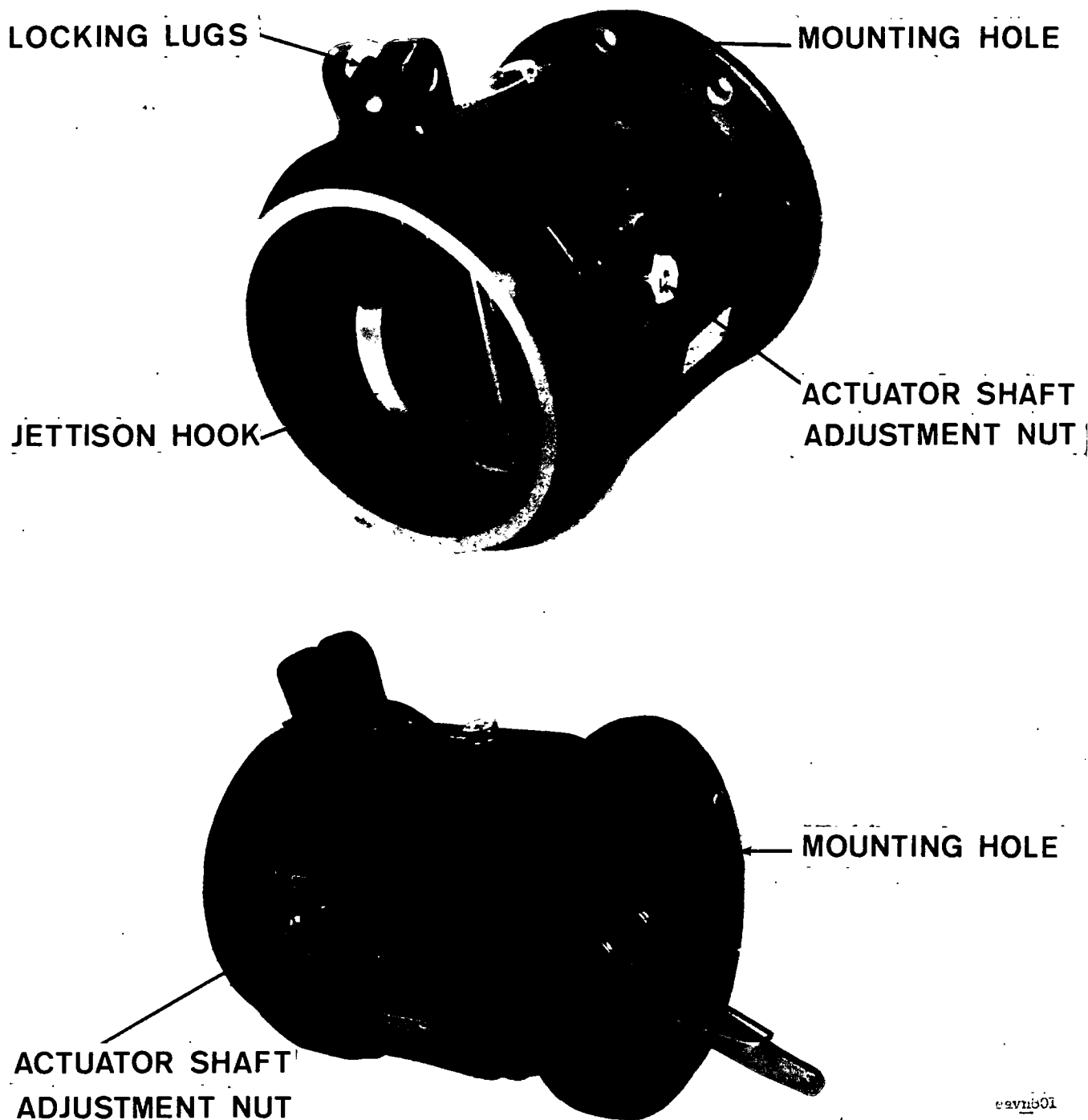


Figure 11-63. Housing assembly.

pletes the electrical circuit between launcher and missile.

(4) *Vertical plate plug and guillotine lock.* On the rear side of the launcher's vertical plate (hidden in fig 11-66) is the seven-pin female connector that mates with the 15-pin plug described in d(3) above. Also located here is the guillotine lock which engages the junction box and, upon missile launch, holds the box in place.

(5) *Launcher guide rails.* The launcher guide rails are in two sections on the bottom of the launcher on both sides (compare the side and bottom views of fig 11-66). These rails receive the four ears of the two missile mounting lugs. The forward rail section (corresponding to the forward mounting lug on the missile) is higher and wider than the rear rail section.

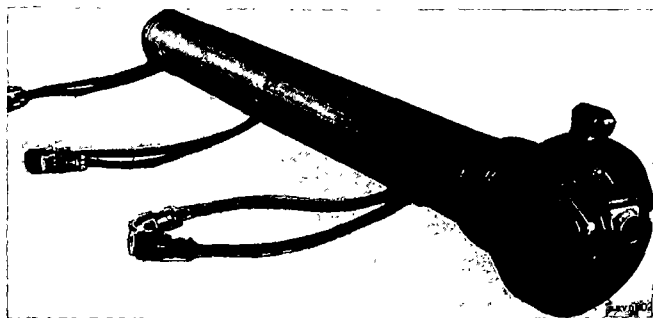


Figure 11-64. Launcher support assembly.

11-32. Internal Subsystem Components

The M22 subsystem components internal to the UH-1 are for missile selection, firing and control, and guidance. The electronics components are completely transistorized. For installation procedures, see TM 9-1400-461-20. For equipment check and circuit tests, see paragraph 11-35. For weights and dimensions of internal components, see table 11-8.

Table 11-8. Weights and Dimensions of Internal Components

Item	Length (in.)	Width (in.)	Height (in.)	Diameter (in.)	Weight (lb)
Guidance Control Unit.....	12¼	5½	6	-----	13
Missile Selection Box.....	10	5	4½	-----	10
Pilot's Sight (including mount).	18	-----	-----	-----	10
Gunner's Sight M55 (including mount).	-----	12	15	-----	18½
Gunner's Sight XM58 (with control amplifier).	-----	7	15	-----	50
Control Stick.....	-----	-----	4	3¼	2
Adapter Kit.....	-----	-----	-----	-----	10

a. *Pilot's Sight* (fig 11-67). The infinity reflex optical sight (Navy Mk 8) is mounted to the roof of the helicopter in front of the pilot. A locking clamp (1) on the mount locks the sight in the operating (vertical) position or the stowed (horizontal) position.

(1) The target is viewed through a flat glass reflector plate (2). This plate adjusts 14° up and down from a zero reference point in making changes in range. The adjustment is by the knurled ring knob that has a degree scale inscribed on it. Next to the degree scale (3) is a fixed scale (4) graduated in mils. A spring brake holds the degree scale in the desired setting.

(2) Inside the sight body (5) is a two-filament 28-volt bulb, a multiple ring reticle (inner ring with 100 mils value) with a 10-mil ladder image, and a lens.

b. *Gunner's Sight M55* (fig 11-68). The M55 antioscillation sight is used by the gunner (copilot) to track the M22 missile after it is fired. The sight is mounted to the helicopter roof in front of the gunner's seat.

(1) *Mount*. A locking clamp (1) on the mount allows positive vertical positioning of the sight for use and horizontal positioning when not in use. The thumb screw (2) is to adjust sight elevation, and the locking lever (3) to adjust sight azimuth.

(2) *Binocular*. The Navy Mk 43 six-power binocular, modified to a fixed focus, is the major component of the sight. An eye lens, a control lens, and a field lens are mounted together. Two erecting prisms of each optical system are fastened to a shelf secured to the cover. The lenses are mounted in a double eccentric ring. This ring permits any adjustment necessary in a plane at right angles to the line of sight.

(3) *Gimbals*. Two gimbals with double bearings permit the binocular to move vertically and horizontally. The vertical gimbal is attached to the outer frame and holds the horizontal gimbal. A pin (4) locks the gimbals together when the gunner's sight is not being used, with a stowing position for the pin when the gunner is using the sight.

(4) *Dashpots*. Two dashpots act in the vertical and horizontal axes to dampen shock. A control knob on each dashpot adjusts the travel limits of a rubber diaphragm. The diaphragm is clamped between the dashpot plate and cover. It and the mounting ring make up the antioscillation system. These two parts vibrate with respect to one another. The diaphragm moves back and forth, forcing air in and out through the openings in a small needle valve, thereby dampening vibrations.

(5) *Headrest*. To prevent the gunner from coming in contact with the gimbals, a headrest (5) is rigidly mounted on the outer frame. It may be locked (6) in any of three positions by lifting the spring-loaded arm and sliding the headrest to the desired position.

c. *Gunner's Sight XM58* (fig 11-69). One half of a Navy Mk 43 six-power binocular, modified to a fixed focus, gives the gunner magnified vision with the right eye (1). A polaroid ring sight (2) with multicolored target rings is for the left eye. The XM58 is mounted to the roof in front of the gunner.

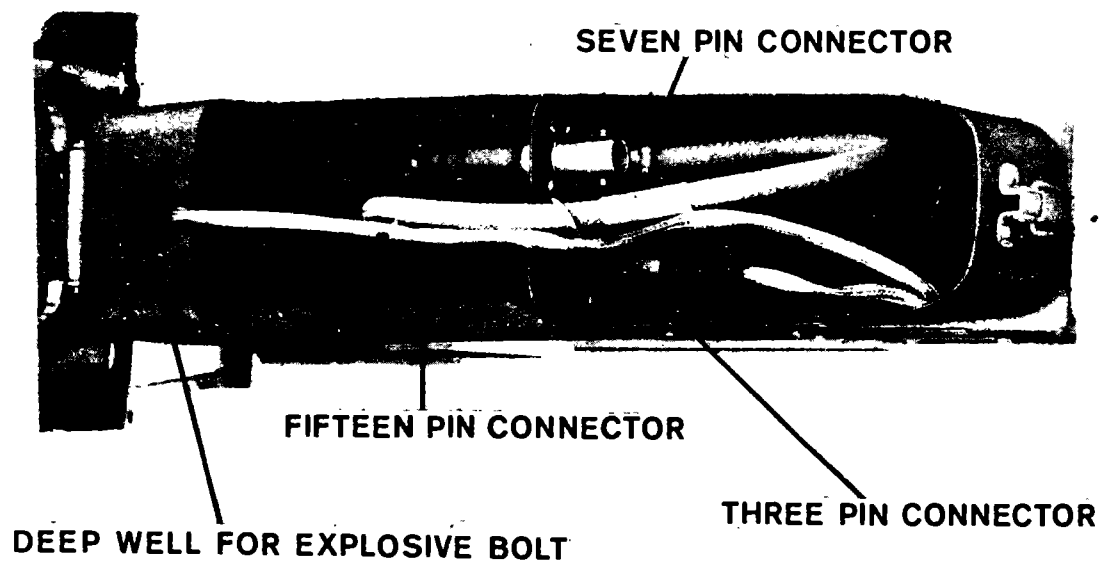
(1) *Mount*. Bolted in existing holes in the helicopter roof, the mount holds the azimuth gimbal and the line-of-sight indicator pickoff synchro



A



B



SEVEN PIN CONNECTOR

FIFTEEN PIN CONNECTOR

THREE PIN CONNECTOR

DEEP WELL FOR EXPLOSIVE BOLT

C

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Figure 11-65. Fixed housing.

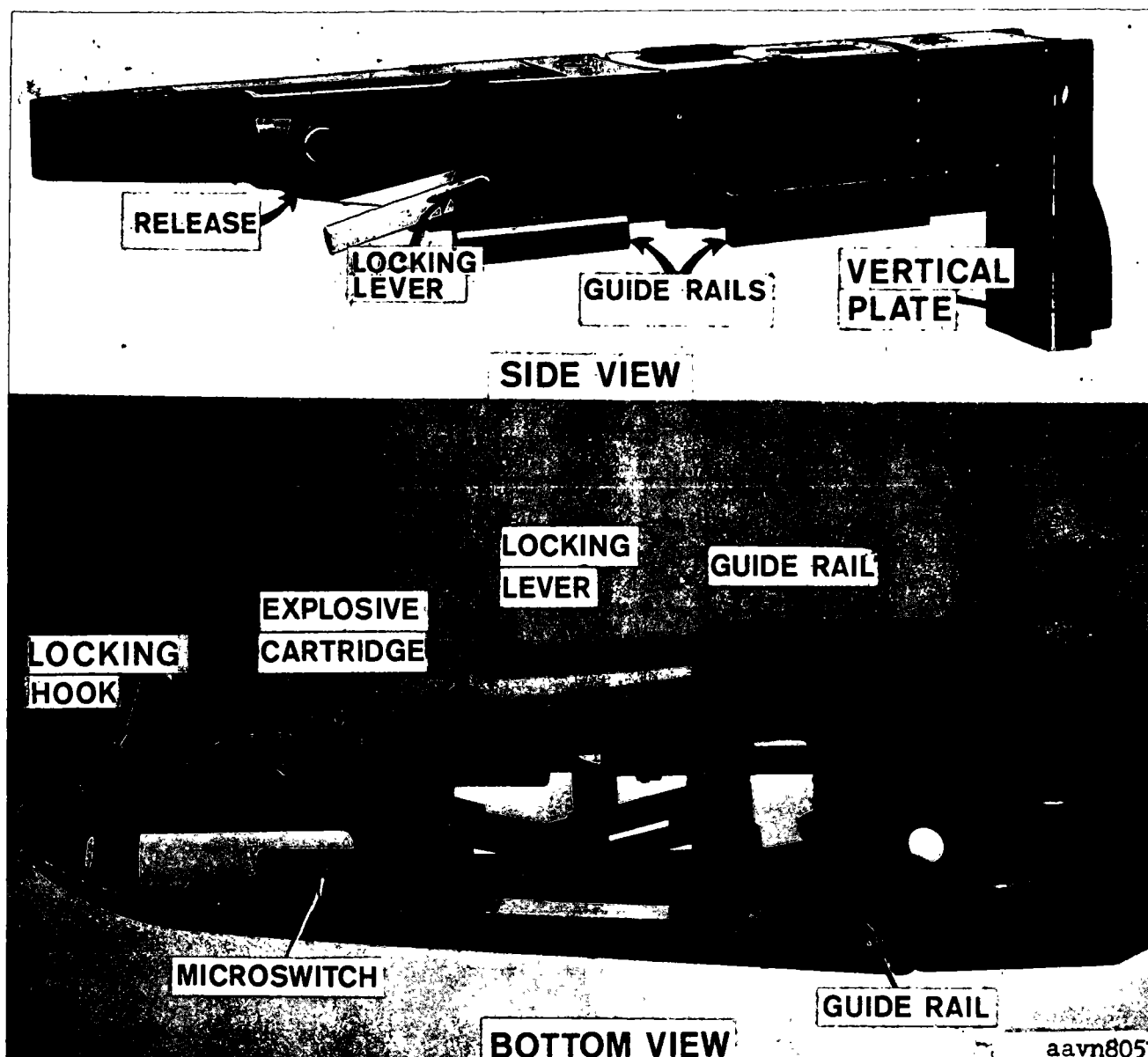


Figure 11-66. Launcher.

((7) below), as well as the sighting system trim controls, control box, and the gimbal position control. DC power of 28 volts is brought into the system at the control box, through the OFF/ON power switch (3), which also acts as a circuit breaker.

(2) *Sights.* The monocular sight consists of an eye lens, a control lens, and a field lens mounted together. The open polaroid ring sight adjusts optically with the monocular.

(3) *Gimbals.*

(a) The balanced azimuth gimbal includes its housing, support arm, and counterweight. It has mechanical stops 45° on either side of the centerline of the helicopter.

(b) The elevation gimbal is fixed to a yoke on the azimuth gimbal support arm. This gimbal houses the monocular and ring sights, and two motion-sensing gyroscopes. The gimbal has mechanical stops 15° up or down from the centerline of the helicopter.

(c) The two gyroscopes, operating independently, sense helicopter motion electrically, then send signals to the control amplifier located on the floor of the helicopter just aft of the M22 guidance control unit. The amplifier then sends counteracting commands to the gimbal motors, which move the sight in direct motion opposite to that of the helicopter.

(d) The sight, once set, will stay on target

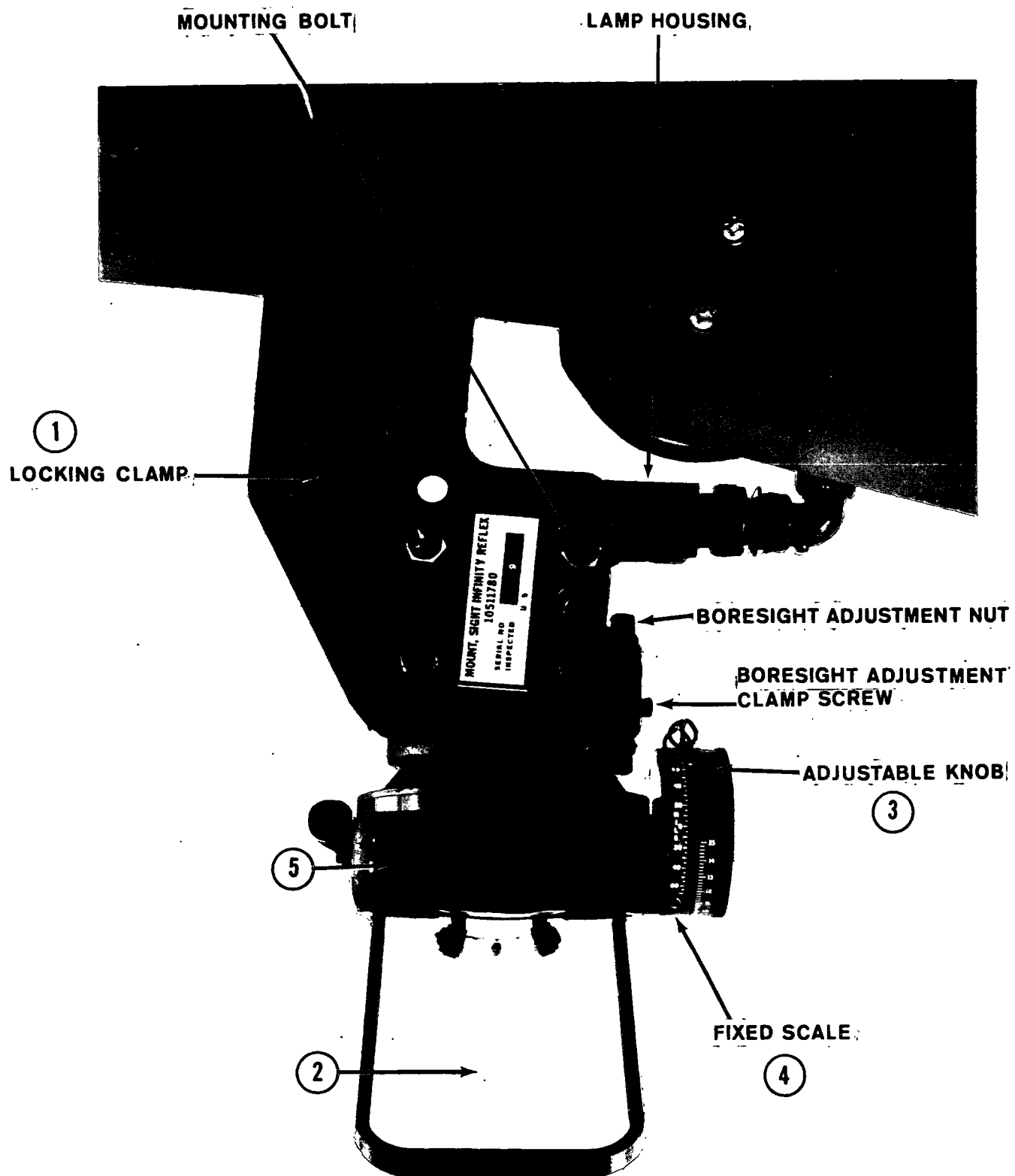


Figure 11-67. Pilot's infinity reflex sight.

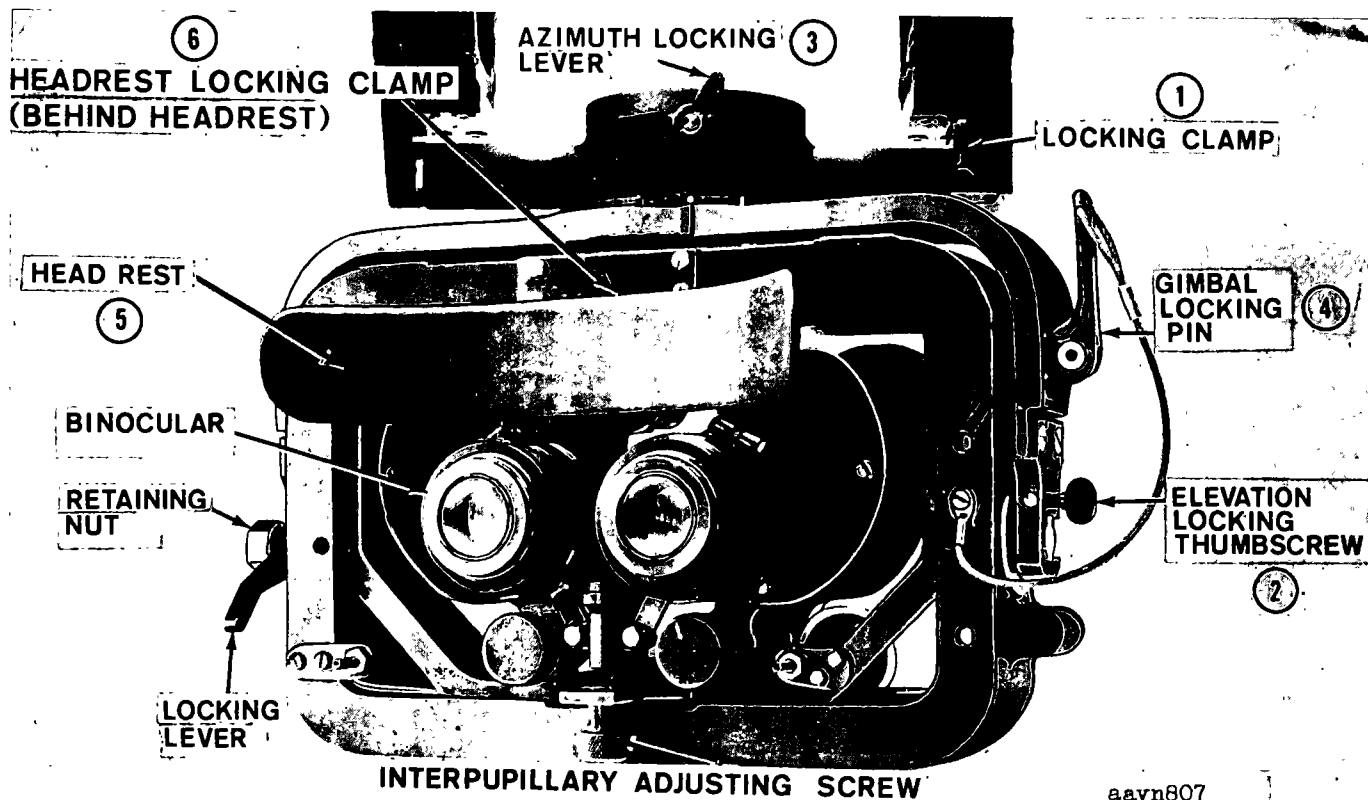


Figure 11-68. M55 gunner's antioscillation sight.

during helicopter motion if the helicopter does not exceed the azimuth limits (45° right or left) or the elevation limits (15° up or down).

(4) *Gimbal position control.* This control (C, fig 11-69) is a button-knob attached to the mount (4). It lets the gunner control the gimbal position both in azimuth and elevation, as much as 20° per second. This makes tracking a moving target possible, even with the sight stabilized. When the gunner gives the knob an azimuth change command, elevation of the sight is controlled by the motion-sensing elevation gyro ((3)(b) and (c) above). If he gives the knob an elevation change command, the azimuth gyro stabilizes the sight. When the sight is moved by gimbal position control commands and then released, the sight stabilizes in the new position until moved again.

(5) *Headrest (5).* The adjustable headrest mounted on the azimuth axis is independent of the gimbal. This allows the gunner a firm head and eye position without placing any loads or torque upon the gimbals.

(6) *Stowage.* When the sight is not being used, the gimbal support arm is allowed to swing into the stowed (or horizontal) position by a locking lever and spring assembly. The headrest shaft is raised to engage with holes in the gimbal hous-

ing for a positive lock of the azimuth gimbal. There are two locking positions:

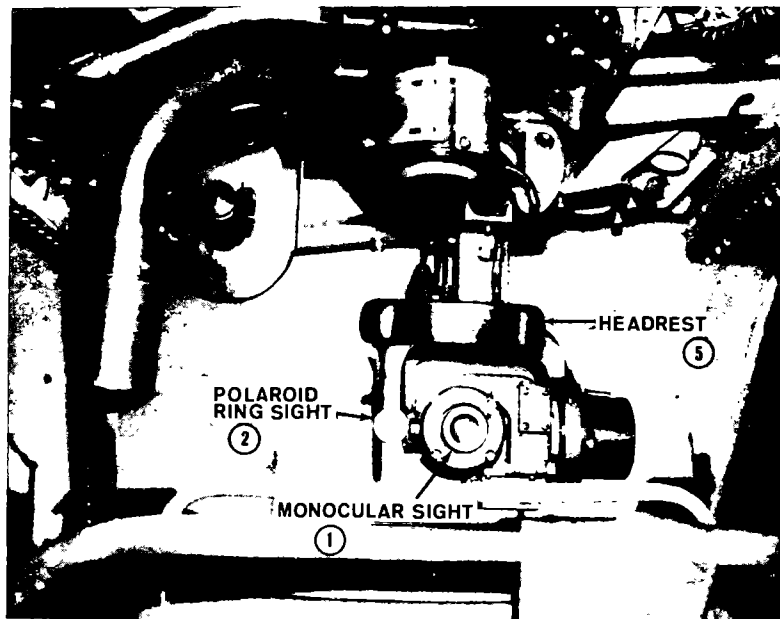
(a) *In-flight stowage position.* For in-flight stowage, the gimbal support arm is placed in a right horizontal position with the counterweight to the left (B, fig 11-69).

(b) *Fore and aft position.* For exiting the helicopter, the support arm and counterweight are placed fore and aft (C, fig 11-69).

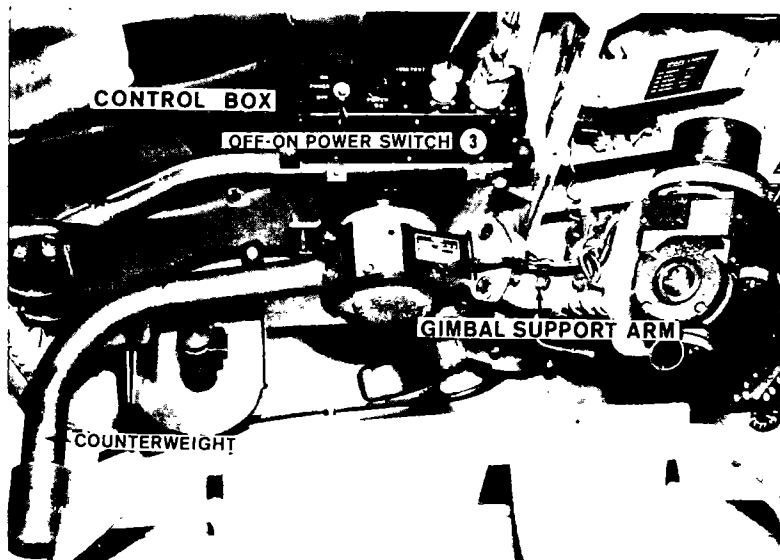
(7) *Line-of-sight indicator.* A line-of-sight indicator is provided for the pilot, and is mounted on the pilot's instrument panel. A transmitting pickoff synchro, geared to the azimuth axis, provides an indication of sight azimuth with respect to the helicopter axis. The indicator is an easy reference for the pilot, so that he can keep the helicopter nose within the 90° travel limits (in azimuth) of the sight (45° left or right of center).

d. *Adapter Kit (fig 11-70).* The UH-1 adapter kit for the M22 subsystem includes—

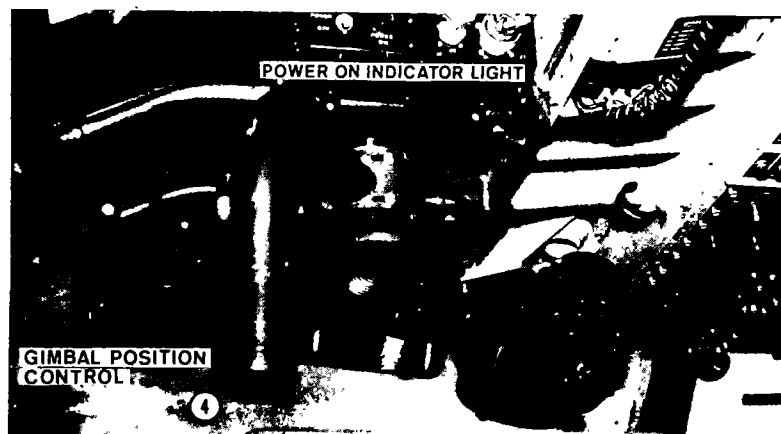
(1) *Base plate.* The L-shaped base plate (1) is attached left and rear of the console to the helicopter floor. It provides a mounting surface for the support assemblies of the arm rest (2), the guidance control unit (3), and the missile selection box (4).



A OPERATING POSITION

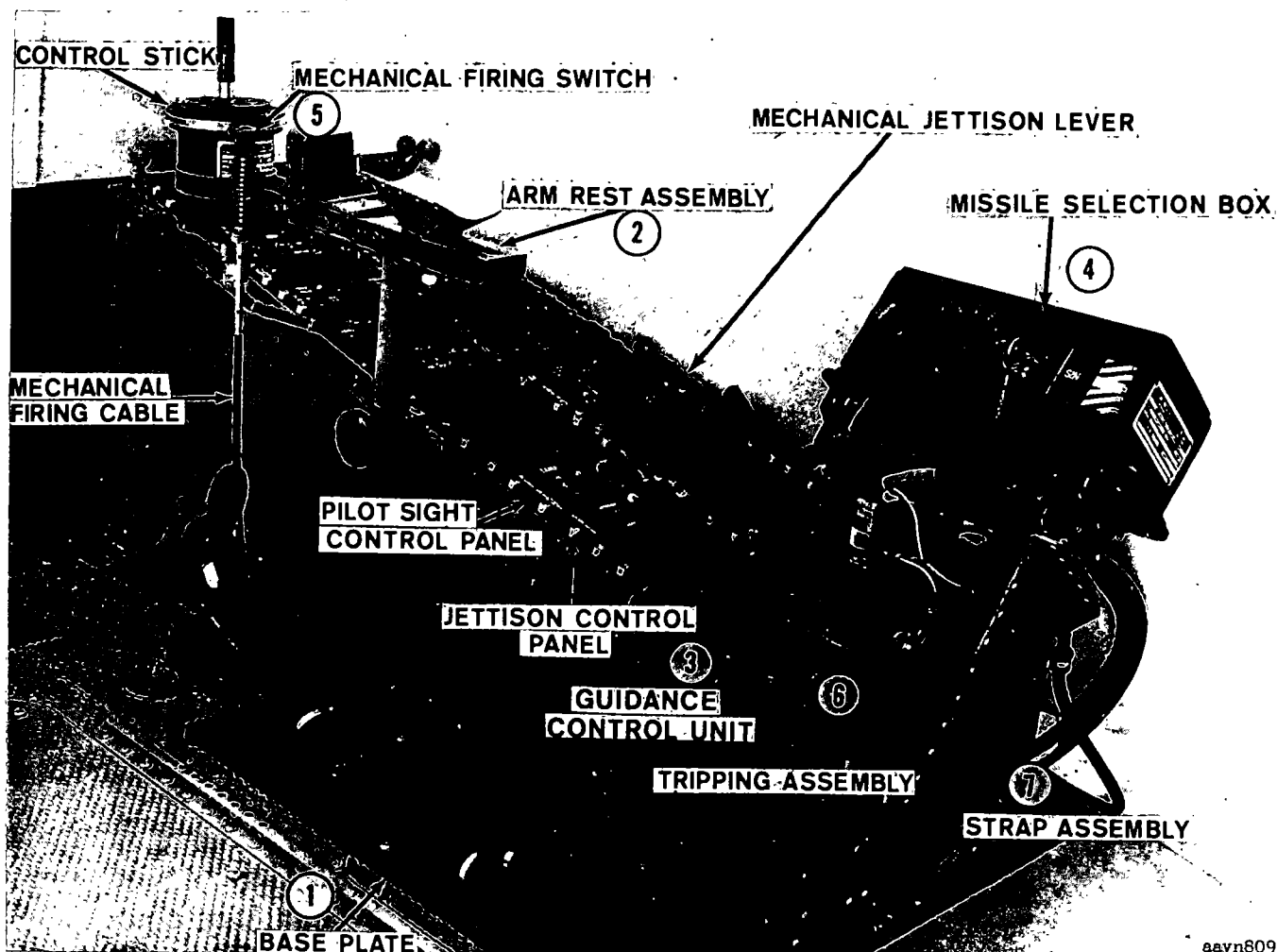


B INFLIGHT STOWAGE POSITION



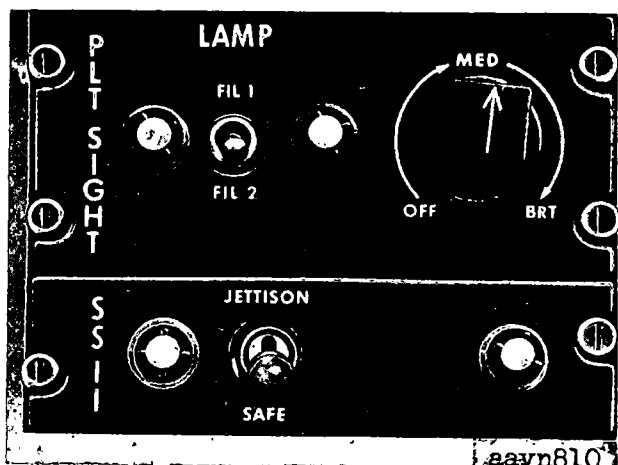
C. FORE AND AFT STOWAGE POSITION

Figure 11-69. XM58 sight.



aavn809

Figure 11-70. Pedestal console—adapter kit installed.



aavn810

Figure 11-71. Pilot's jettison and sight control panels.

(2) *Arm rest assembly.* The arm rest assembly at the right side of the gunner is mounted on a tubular stand that can be adjusted for height. The horizontal part adjusts fore and aft, having the control stick clamp at the forward end and the mechanical firing switch (5) just behind this

clamp. This switch has a spring and plunger cable assembly that leads to a tripping assembly (6).

(3) *Support assembly.* The support assembly of sheet metal is mounted on the base plate. It provides a mount and strap assembly (7) to secure the guidance control unit and a shelf for the missile selection box and its connector shield.

(4) *Pilot's jettison control panel* (fig 11-71). This panel on the lower left of the console has a two-position lock switch. The pilot can jettison all missiles and launchers by pulling the switch out and pushing it up from the SAFE to the JETTISON position.

(5) *Pilot's sight control panel* (fig 11-71). This panel just above the jettison panel has a two-position toggle switch on the left to select one of two bulb filaments and rheostat on the right to control the light intensity of the reticle in the pilot's sight.

(6) *Mechanical jettison lever and system.* The mechanical jettison lever (fig 11-72) on the

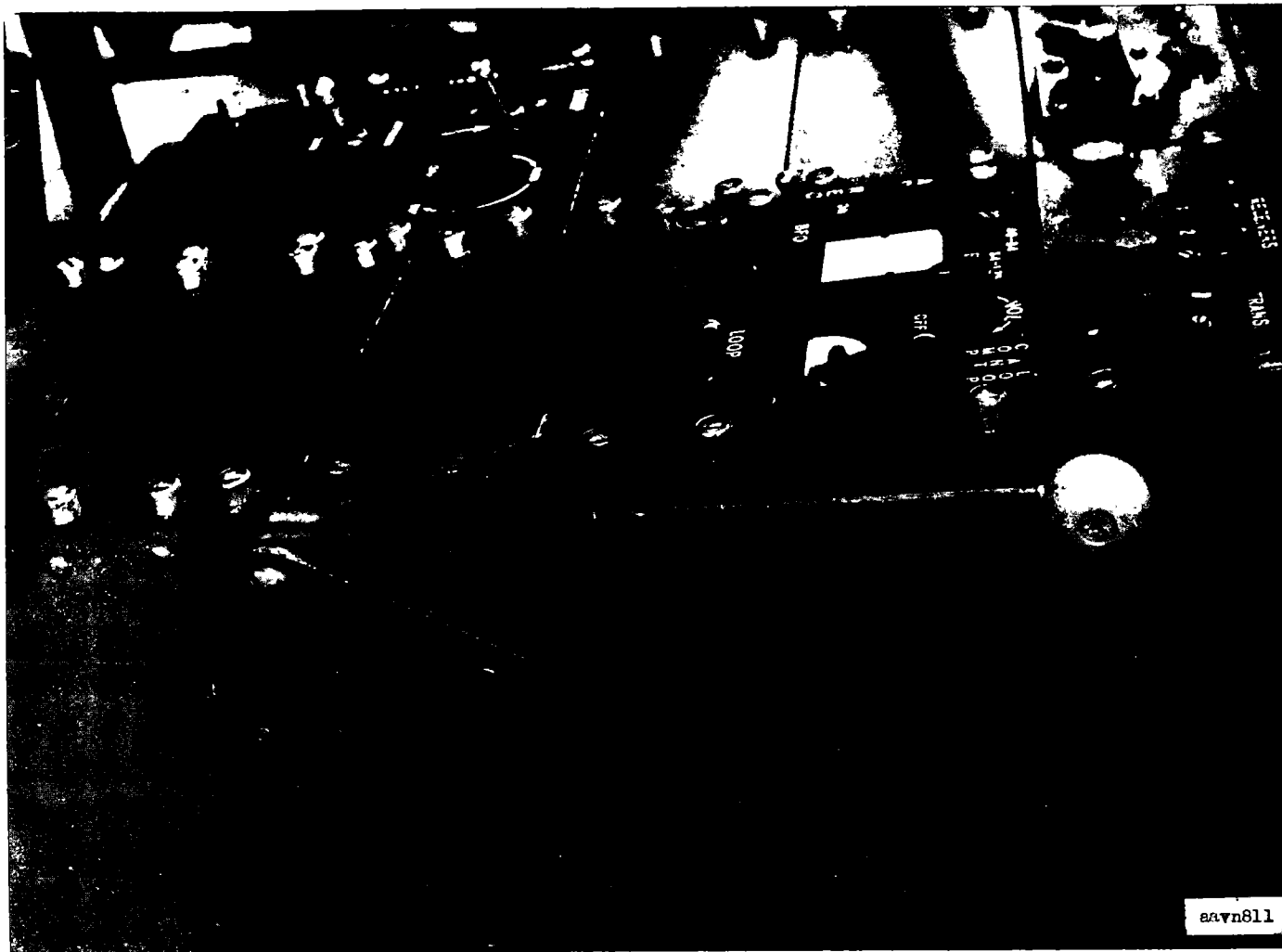


Figure 11-72. Pilot's mechanical jettison lever.

right side of the console has a sheet metal hood to prevent accidental raising of the lever to the jettison position. The mechanical jettison system (fig 11-73) includes five cables, a bellcrank, five turnbuckles, pulleys, and two quick disconnects. As can be seen by following the cable route in figure 11-73—

(a) The forward cable leads from the pilot's jettison lever to the bellcrank under the floor.

(b) Two cables exit right and left from the bellcrank to quick disconnects on each side of the helicopter.

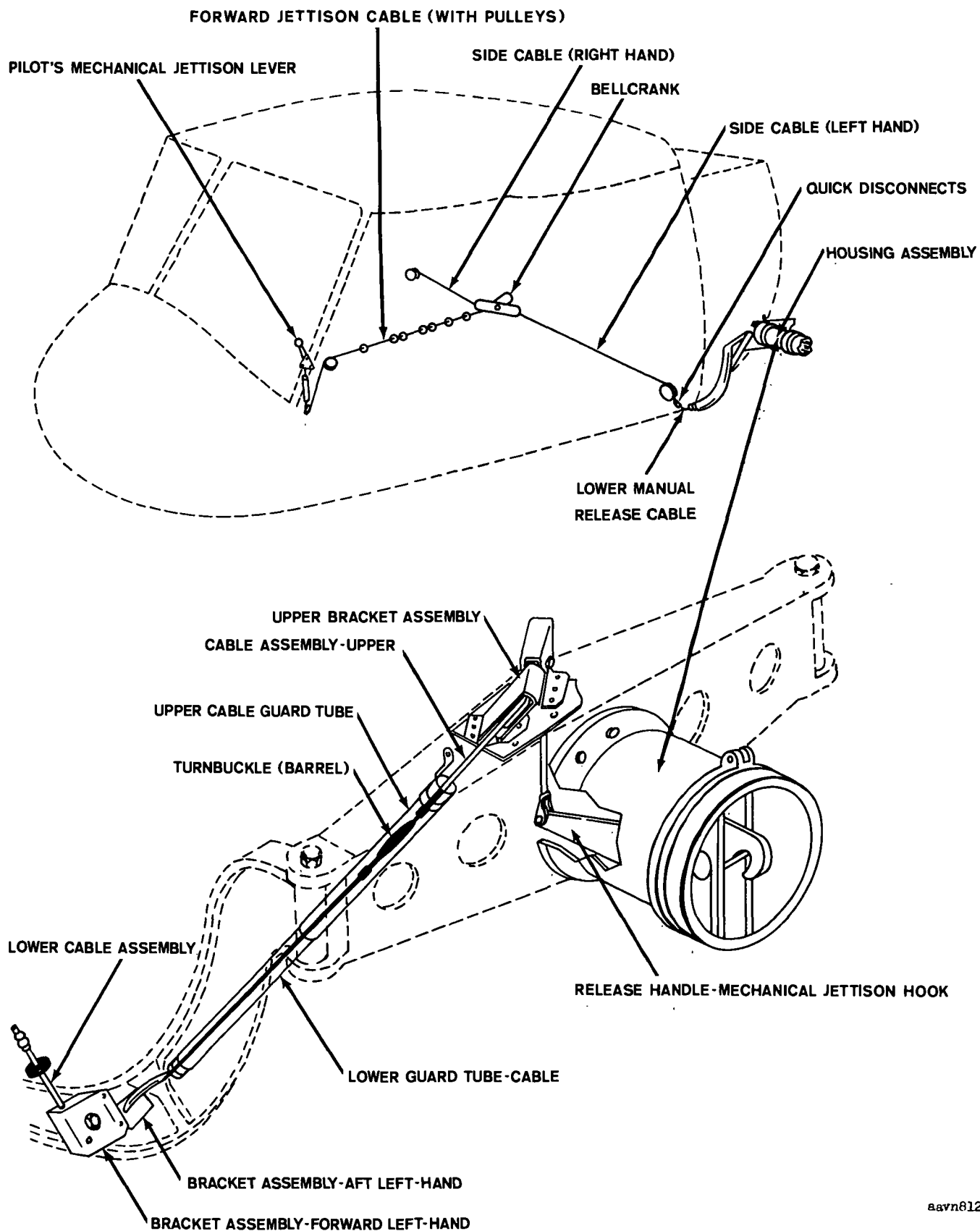
(c) Each quick disconnect attaches to a cable running through an access panel adjacent to the forward external stores mounting. These cables then lead through guard tubes to turnbuckles that connect to the final cable leading to the mechanical jettison hook in the housing assembly.

e. *Control Stick.* The control stick (fig 11-70) is held in the neutral position by a centering device and may be moved in all directions. Two variable

resistors are inclosed in the base (one for pitch, one for yaw), with two sliding taps attached to the hand-operated lever. At the bottom of the base is a seven-pin plug for the cable that carries the resistor readings to the guidance control unit. Movement of the control stick generates and transmits guidance commands to the missile. Forward movement commands "down" for the missile, rearward movement commands "up," to the right commands "right," and to the left commands "left." Since the control stick can be moved diagonally, the gunner can combine "up-left," "up-right," "down-left," or "down-right" commands.

Note. To insure proper installation of the control stick, pull up on it and then fold it. When the stick is folded, it will point forward.

f. *Guidance Control Unit (fig 11-74).* The completely transistorized guidance control unit (GCU) is located to the right-rear of the gunner, behind the helicopter's center console. This unit contains the signal generator module that con-



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Figure 11-78. Mechanical jettison system.

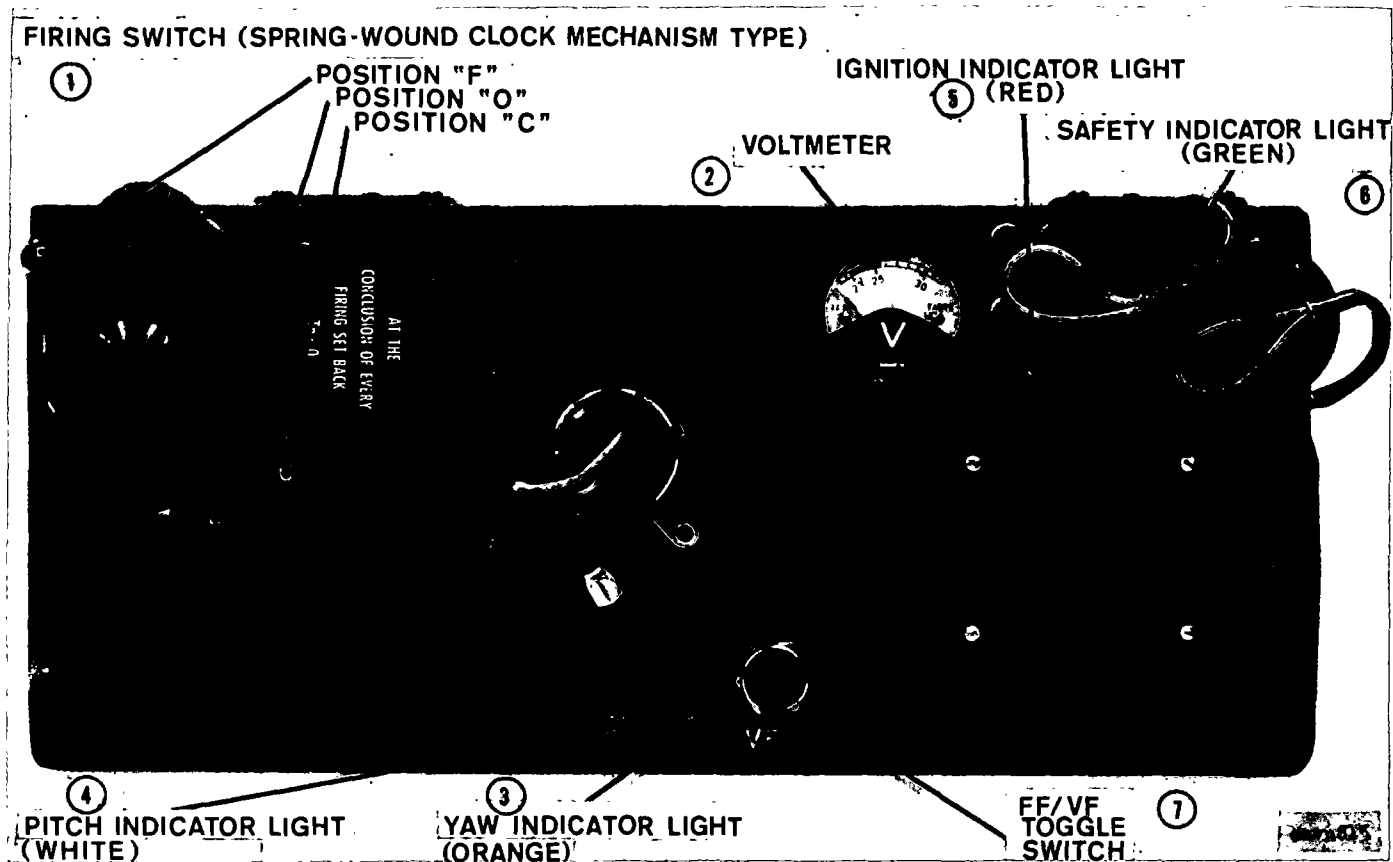


Figure 11-74. Guidance control unit—controls and indicators.

verts the control stick movements to the missile guidance commands (signals).

(1) *Firing switch.* The firing switch (1) has a mechanical stop to hold it in the "O" position. To test the input voltage and the pitch and yaw signal output of the coder, the switch is held counterclockwise in the "C" position. In this position, the operational readiness can be determined by observing the voltmeter (2), yaw indicator light (3), and pitch indicator light (4). When the firing switch is lifted over the mechanical stop and released, the spring mechanism in the firing switch pushes the switch through the IG, UG, FB, and "F" positions (para 11-33b).

(2) *Voltmeter.* This meter indicates voltage input from helicopter electrical power supply.

(3) *Yaw indicator light.* This orange light oscillates on and off to indicate yaw command output of the signal's coder when firing switch is held in "C" (test) position.

(4) *Pitch indicator light.* This white light oscillates on and off to indicate pitch command output of the signal generator module when firing switch is held in "C" (test) position.

(5) *Ignition indicator light (5).* This light

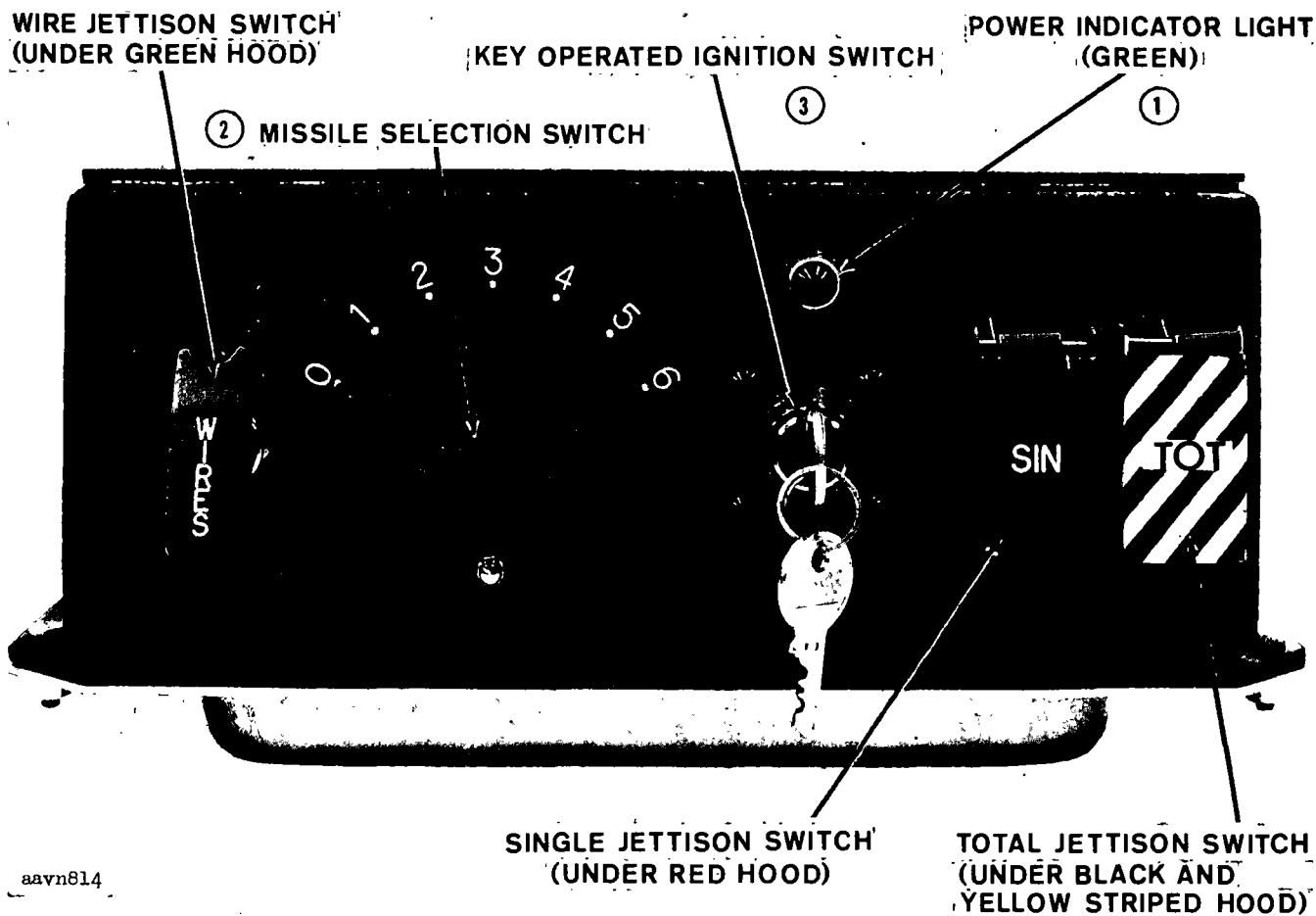
glows red when the firing switch is lifted over the mechanical stop and is at the IG, UG, or FB positions, indicating that power is being applied to the ignition circuits of the missiles and launchers.

(6) *Safety indicator light (6).* This light glows green when the firing switch is at "F" position. It continues to glow until the switch is reset to the "O" position. The green light indicates that ignition and firing circuits are disconnected.

(7) *FF/VF toggle switch (7).* This two-position switch allows a fixed frequency (FF) or a variable frequency (VF) output. At the VF position, the signal generator module produces a signal increasing from 10 to 16.5 cycles per second. The FF position is not normally used, but is recommended for all firings over 100 knots launching speed.

g. Missile Selection Box (fig 11-75). The missile selection box applies primary power to the armament subsystem from the helicopter power supply. The single and total jettison switches are separate circuits, unrelated to the key switch circuit. Output from the missile selection box is cabled to the electrical connectors of the UH-1 just below the rear doorsills outboard.

Note. Be careful not to lose the two keys supplied with the missile selection box. All keys do not fit all boxes.



aavn814

Figure 11-75. Missile selection box—controls and indicators.

(1) *Power indicating light (1)*. This light glows green when the key switch is turned on, indicating that voltage from the helicopter power supply is being applied to the missile subsystem.

(2) *Missile selection switch (2)*. This seven-position rotary switch connects firing, guidance wire-jettison, and individual jettison circuits to missiles and launchers and allows the gunner to select the missile to be fired. The 0 position is off; positions 1 through 6 correspond to missiles or launchers 1 through 6.

(3) *Key switch (3)*. This switch connects voltage from the helicopter power supply to the missile subsystem.

(4) *Wire jettison switch (under green hood marked WIRES)*. This spring-loaded toggle switch applies voltage to wire-jettison cartridges in the missile junction box.

(5) *Single jettison switch (under red hood marked SIN)*. This spring-loaded pushbutton switch applies voltage to the explosive bolt of that

launcher which is selected by the gunner on the missile selection switch.

(6) *Total jettison switch (under black and yellow "TOT" hood)*. This spring-loaded pushbutton switch applies voltage to all of the explosive bolts securing launchers to the fixed housings. All launchers are jettisoned simultaneously.

11-33. Subsystem Operation

a. *Mechanical and Electrical Functions*. The overhead panel shown in figure 11-76 contains these M22 circuit breakers:

MK VIII SIGHT PWR
XM58 SIGHT PWR (when installed)
SS-11 MISSILE JETTISON
SS-11 MISSILE POWER

After the two SS-11 circuit breakers are pushed in, primary power is applied to the subsystem by turning the ignition key and setting the missile selection switch to the desired position. For sequence and time of events after release of the

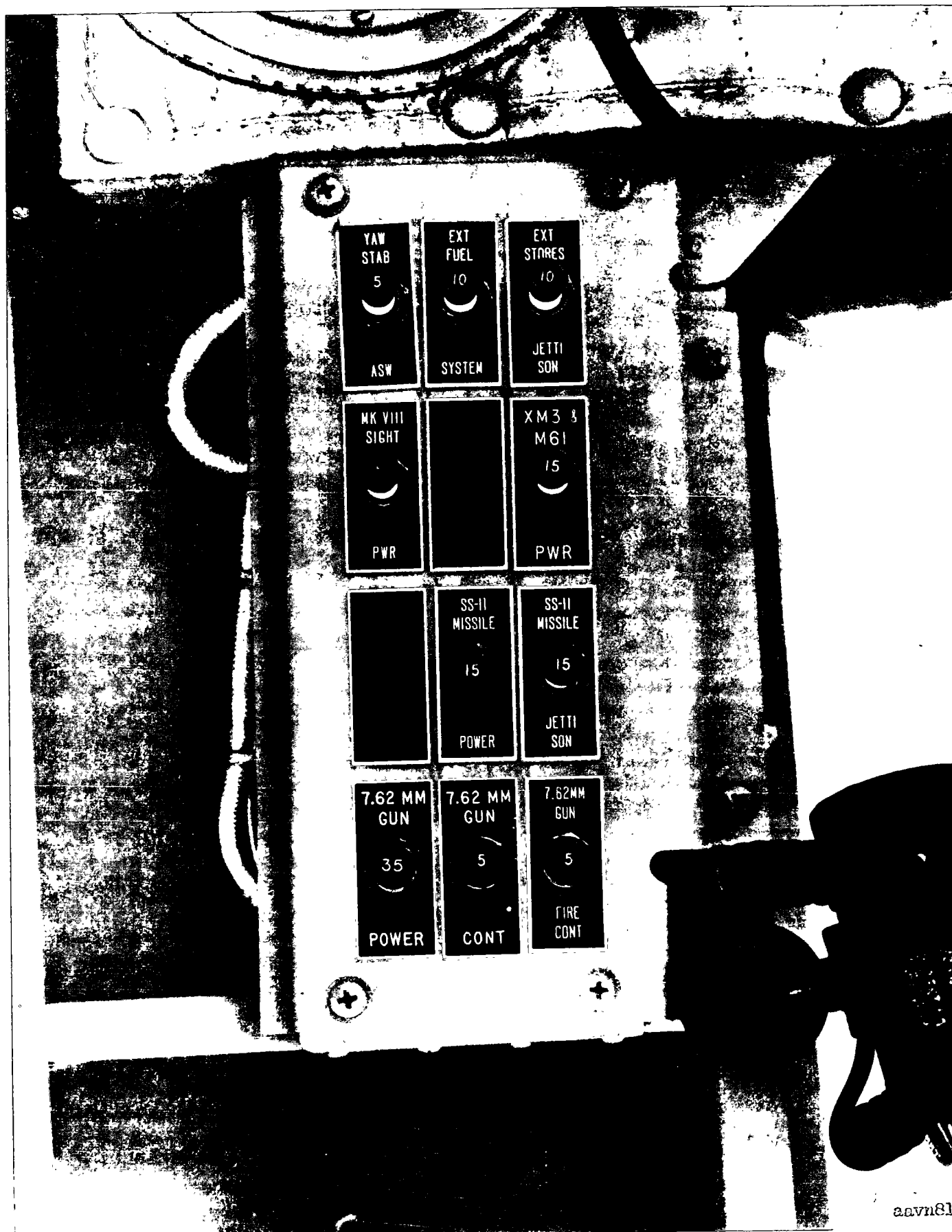


Figure 11-76. Overhead circuit breaker panel.

Table 11-9. Firing Sequence and Table of Events

Event	Time interval (seconds)	Time elapsed (seconds)
1. Firing switch released from "O" position.....		T + .0
2. Firing switch reaches IG position..... a. Explosive cartridge is detonated, releasing locking hook. b. Locking hook disengages from missile body and depresses microswitch. c. Microswitch completes electrical circuit to missile and to gyro igniter filament. d. Gyro powder charge ignites, accelerating gyro to approximately 40,000 rpm in 0.15 second.	0.5	T + .5
3. Firing switch reaches UG position..... a. Gyro uncaging solenoid energized. b. Gaging arm releases gyro gimbals and closes missile battery switch.	0.5	T + 1.0
4. Firing switch reaches FB position..... a. Two flares ignited, to burn for duration of missile flight. b. Booster motor ignited, generating 9 G of thrust for 1.4 seconds. c. Delay squibs ignited, to burn for 0.6 second. d. Missile launches, after approximately 0.1 second of booster motor ignition.	0.5	T + 1.5
5. Firing switch reaches "F" position, completing command circuit to missile and disconnecting all firing circuits.	0.5	
6. Delay squibs burn out..... a. Ball valves open, allowing hot gases to enter sustainer motor chamber. b. Sustainer motor ignites, generating 1.2 G of thrust for 20 seconds. c. Ball valves close from sustainer motor gas pressure, and gunner gains control of missile. d. Warhead arms from sustainer motor gas pressure at about 300 meters from launch.....	0.6	T + 2.1
7. Impact of missile (at any range up to a maximum of 3,500 meters). a. Weighted striker goes forward into detonator, causing ignition. b. Detonator ignition causes explosion of HEAT shaped charge. c. Gunner actuates WIRES switch; explosive charges in junction box are detonated, blowing the wires away from the helicopter.	3.2	T + 5.3
8. Firing switch is returned to "O" position, which disconnects the command circuit.		

firing switch from the "O" position, see table 11-9. The mechanical and electrical functions of the subsystem during a firing sequence are described below.

b. Initiating Firing Sequence (fig 11-77). The firing switch can be seen on top of the guidance control unit (fig 11-70 and 11-74). The switch is lifted over the mechanical stop at the "O" (off) position and released directly by the gunner or remotely through the tripping assembly when he actuates the mechanical firing switch. When released, the spring mechanism pushes the switch clockwise through the IG, UG, FB, and "F" positions.

(1) *IG position.* When the firing switch reaches the IG position, positive and negative voltage is routed through the selection box to the explosive cartridge of the selected launcher. But the voltage to the gyro is blocked by the launcher's open microswitch.

(a) When the explosive cartridge detonates, the locking hook disengages from the missile body and leaves the missile free to launch when thrust is applied. The spring-loaded locking

hook snaps up and depresses the microswitch, completing the circuit to the missile.

(b) The positive 24 volts through junction box plug pin 3 and microswitch, with the negative 24 volts through pin 5 and microswitch, detonates the igniter filament in the gyro powder charge.

(c) Upon detonation, the igniter wires are retracted by a spring in the gyro case and the protective cocoon is blown away from the gyroscopic distributor. (The force of the charge accelerates the gyro to approximately 40,000 revolutions per minute in 0.15 second.)

(2) *UG position.* In the UG position, voltages reach pins 6 and 5 of the junction box in 0.5 second after gyro ignition (T + 1.0 second)*. This sequence drops the spring-loaded gyro locking arm and frees the gyro gimbals. Upon dropping, the arm locks the missile battery circuit switch in the closed position. This completes the circuit within the missile—from batteries to decoder to jetavator electromagnets.

(3) *FB position.* At 0.5 second after the gyro

*T = Time at which the firing switch actuates.

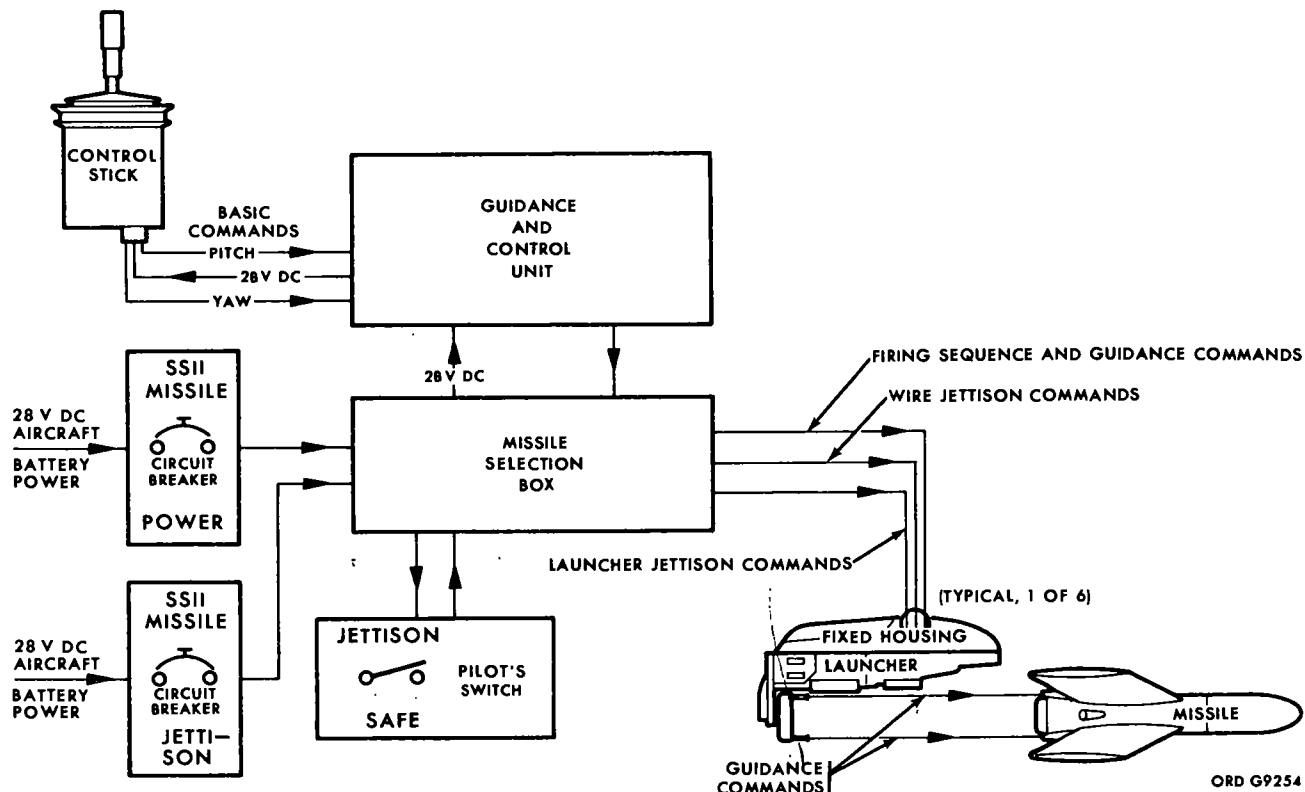


Figure 11-77. M22 armament subsystem, block diagram.

uncages ($T + 1.5$ seconds), the voltage reaches pins 7 and 5 of the junction box. Pin 7 voltage (positive) goes through the 10-ohm resistors to the two flares and the booster motor.

(a) The resistors prevent igniter fusings. Such fusings would cause a short circuit drawing maximum voltage and burning out the missile circuitry.

(b) The two flares are ignited, and the plastic caps are blown off the ends of the flares. Also the booster motor is ignited, burning for about 1.4 seconds and generating 9 G (583 pounds) of thrust.

(c) The pellets sealing the chamber from moisture are blown out by gas pressure and thrust is channeled out the exhaust nozzles, initiating launch.

(d) Under booster thrust, the missile accelerates to a speed of about 195 miles per hour.

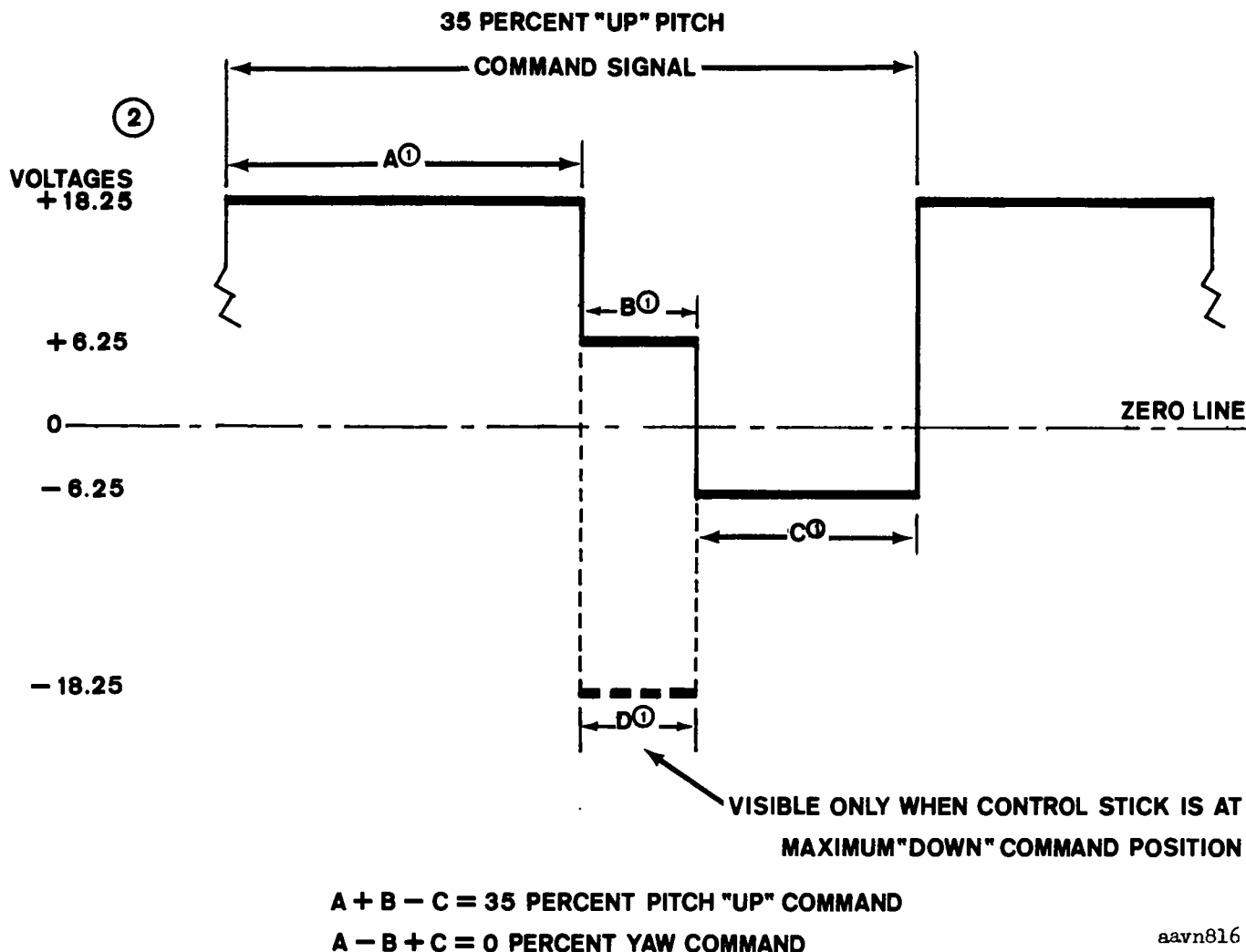
(4) "F" position. When the "F" position is reached, electric power to all circuits is cut off except that to the command circuit. The firing circuits remain deenergized until the firing switch is returned to the "O" (off) position.

c. *Launch.* The missile leaves the launcher almost instantly after booster motor ignition. Each spool of wire (3,300 meters) starts paying out from the two spool assemblies in the missile back

to the fastened junction box end on the launcher. The missile wings provide lift and, being offset 48 minutes from the long axis of the missile, spin. The spin rate varies from 3 to $3\frac{5}{8}$ revolutions per second, according to the missile velocity.

d. *Sustainer Ignition.* At the time of booster ignition, two delay squibs on ball valves are ignited. After 0.6 second ($T + 2.1$ seconds), the squibs burn out and open the ball valves, allowing a small amount of the hot gases from the booster motor to enter the sustainer motor chamber. These hot gases ignite the ring charge ignition casing of the sustainer motor, and the motor burns forward from its rear face. When the gas pressure from the sustainer motor equals that of the booster motor, the ball valves close. The protective celluloid pellet is then blown out of the exhaust tube, with sustainer motor gases channeled out through the sustainer exhaust tube. The sustainer motor burns for about 20 seconds and provides 1.2 G (77 pounds) of thrust. It continues the acceleration of the missile until it reaches a speed of about 425 miles per hour at maximum range.

Note. Since solid propellant combustion speed varies with temperature, the thrust of both the booster and sustainer motors will vary. Thus, missile speed and motor burnout time varies proportionally with temperature. The motor operating limits are -36°C . to $+56^{\circ}\text{C}$., giving an operating guarantee for temperatures ranging from -80°



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Figure 11-78. Amount of command by gunner in relation to voltage.

C. to +50° C. On a cold day, thrust and missile speed reduce, while motor burnout time and, hence, missile flight time increase.

e. Missile Guidance. Up to this time, the missile has been in free flight, governed only by azimuth displacement of the helicopter's longitudinal axis at time of launch and the initial trajectory angle set into the fixed housing and launcher by the gunner. With the sustainer motor burning and providing exhaust for the jetavators to deflect, missile guidance is now possible.

(1) Pitch and yaw commands are sensed by the taps on the control stick variable resistors and routed to the signal generator module in the guidance control unit to be coded. The coded command is then sent through the missile selection switch to pins 1 and 2 of the missile junction box (which has remained on the launcher). In voltage, the coded commands are as follows:

(a) *Pitch up*—large or small positive voltage.

(b) *Pitch down*—large or small negative voltage, or zero voltage (broken circuit).

(c) *Yaw left*—large positive or negative voltage.

(d) *Yaw right*—small positive or negative voltage, or zero voltage (broken circuit).

(2) For voltages in (1) above, high voltage is 18.25 volts (+1.5 or -1.0). Low voltage is 6.25 volts (+0.5 or -0.5). The amount of command given by the gunner (100 percent left or "hard" left, 50 percent left, 25 percent left, etc.) is defined by the *length* of a square wave ((1), fig 11-78) sent by the guidance control unit. The voltage being applied is defined by the *height* (depth) ((2), fig 11-78) of the square wave in relation to a false zero line. With the control stick in a neutral position, a "35 percent up" command is being sent to the missile to overcome gravitational pull.

(3) The command travels to the decoder over

the two guidance wires paying out from the missile. The decoder separates "up," "down," "left," or "right" commands. Since either wire is positive and the other negative, the two wires from the junction box to the missile form a complete circuit. Thus, if one wire should break, the decoder would receive a zero signal (resulting in a "down and right" command) and the missile would destroy itself.

(4) Each command from the decoder (fig 11-59) has its own positive lead connected to a wiper. These wipers are contacts for the slip rings on the gyroscopic distributor. The slip rings are wired internally to a particular segment of the four-segment commutator. The slip ring(s) being energized transmits the command impulse to the segment(s) of the commutator being energized.

(5) A negative lead from missile batteries to all electromagnets of the deflector assembly has already been applied. Four wipers brushing each segment of the commutator then supply the positive lead to actuate the appropriate electromagnet. These electromagnets pull one jetavator into the sustainer exhaust and pull the opposing jetavator out. This is accomplished for each command given. The percentage of command given (25 percent, 50 percent, 75 percent, etc.) determines how long the electromagnets accomplishing this command will stay positive. (An electromagnet will stay positive 25 percent of the time for a 25 percent command, 50 percent of the time for a 50 percent command, etc., for as long as that command is held by the gunner.)

Note. Because of the segmented commutator, the command will be interrupted for the length of time it takes the wiper to go over the insulation between the segments.

(6) As the missile rotates about the gyro, slip rings, and commutator, the eight wipers (four sending signals and four receiving signals) and the jetavators and their electromagnets also rotate. This missile rotation has no effect on transmission, but the receiving wipers are continually changing segments of the commutator. Since only one segment is positive for a given command, this changes the electromagnets receiving the command. In this manner, the electromagnets being actuated correspond directly to the missile roll rate, and the jetavators being moved in or out of the exhaust are in the proper position for any given command.

f. Arming of the Fuze Detonator Assembly.

(1) Aside from the sustainer motor gases for guidance control, a small portion enters the arming orifice of the fuze detonator assembly (A, fig 11-57) through the three small tubes molded into the motor. Gas pressure on a flexible sealed dia-

phragm breaks a shear pin on a plunger. This upward movement forces the red plastic piston out (B, fig 11-57) and lets the weighted firing pin striker rest against the detonator. A light coil spring holds the firing pin striker against the detonator until missile impact.

(2) Arming of the fuze detonator occurs 3.2 seconds after sustainer motor ignition ($T + 5.3$ seconds) or about 300 meters from the point of launch.

g. Warhead Detonation. At impact, the weighted firing pin (f(1) above) is driven forward against the detonator by inertia. The striker enters the detonator, it explodes, and the warhead detonates.

h. Wire Jettison. After missile impact, wire jettison is accomplished by activating the wire jettison switch on the missile selection box. This applies voltage through the selection switch to pin 4 of the junction box and to each of the two control wire attachment jacks. Explosive squibs cause ignition of a small powder charge in the jacks, blowing away the guidance wires (and a detachable portion of the jack) from the helicopter. Upon release, the spring-loaded jettison switch returns to the off position.

11-34. Missile Jettison Emergency Procedures

Helicopter malfunction may require a forced landing while loaded with tactical rounds (HEAT). The missiles should be jettisoned at least 50 feet above the terrain by use of the TOT jettison switch, the pilot's electrical jettison switch, or the pilot's mechanical jettison lever. If time allows (as when some of the missiles have been fired), individual missiles should be jettisoned with the SIN switch.

a. Simultaneous Jettison of All Missiles and Launchers.

(1) *By gunner.* The gunner can electrically jettison all launchers and missiles by depressing the TOT jettison switch. Voltage is applied to all explosive bolts simultaneously.

(2) *By pilot.* The pilot can electrically jettison all launchers and missiles with the pilot's electrical jettison switch. Voltage is applied to all explosive bolts.

b. Single Launcher and Missile Jettison. In an emergency, the gunner may jettison a single launcher and missile. The missile to be jettisoned is selected and the SIN jettison switch depressed. Voltage is applied to the explosive bolt of the selected missile's fixed housing assembly.

c. *Mechanical Jettison.* The pilot can mechanically jettison the missiles by pulling up on the mechanical jettison lever (fig 11-72). This activates the jettison hooks in the housing assemblies on both sides of the helicopter. The launcher support assemblies, internal electrical cabling, fixed housing assemblies, launchers, and all missiles fall away from the helicopter.

Caution: Mechanical jettison should not be attempted when the helicopter is loaded with tactical rounds (HEAT) unless the altitude is at least 50 feet above the terrain.

11-35. Test Equipment

The purpose of the M22 test equipment is to insure proper component performance prior to loading. It enables the crew to check the explosive

cartridge circuit, ignition and firing circuits, wire jettison circuits, launcher jettison circuits, amplitude of control signals, percentage of the command signals, the command signal frequency, missile battery power, and launcher elevation. For functioning of this equipment, see TM 9-1400-461-20.

11-36. Subsystem Failures—Probable Causes and Procedures

Table 11-10 lists several possible subsystem failures (or personnel errors) which would cause the missile not to leave the launcher, or to fail during flight. The table also includes procedures to be performed to correct the situation whenever possible.

Table 11-10. M22 Guided Subsystem—Failures, Causes, and Procedures

Malfunction	Probable cause and procedures
	Warning: Do not cut the power at the selection box unless the missile takes a maximum up and left path. If the malfunction is in the decoder pitch channel and the power switch is cut, the missile will take a maximum up and right path.
1. Missile takes a maximum up and right (or left) path...	Defective missile, control stick, selection box, or GCU. Set the key switch in the selection box to the OFF position.
2. No ignition of explosive cartridge, flare, or booster.....	a. SS-11 MISSILE POWER circuit breaker pulled out or selection box key switch off. Push in circuit breaker or set key switch to the ON position. b. Wrong setting on missile selection switch. Select the proper missile. c. Cables broken or not connected, low voltage supply, faulty selection box, faulty explosive cartridge, or faulty GCU. Upon return of the helicopter, circuits should be tested with the circuit tester.
3. Ignition of explosive cartridge, release hook disengages, but missile flares or rocket motors do not ignite.	Defective cables, selection box, microswitch in launcher, or missile. Jettison the missile. Warning: Missiles with HEAT warheads should be jettisoned from an altitude of at least 1,500 feet. Select the proper missile.
4. Explosive cartridge ignites, but release hook does not disengage.	Defective launcher. Jettison the missile. Select the next missile.
5. Ignition of explosive cartridge and flares, but no ignition of booster.	Faulty booster (ignition circuit). Missile should be jettisoned. Warning: Missiles with HEAT warheads should be jettisoned from an altitude of at least 1,500 feet.
6. Ballistic flight.....	Defective missile. No procedure required.
7. Spiraling flight.....	Defective missile. No procedure required.
8. Missile goes down and right.....	Broken control wire or low helicopter supply voltage. No procedure required.
9. Missile takes a maximum left or right path.....	Defective missile, control stick, or GCU. Give maximum down command on control stick. If this does not ground the missile, cut the power at the selection box.
10. Missile takes a maximum up or down path.....	Defective missile, control stick, or GCU. Guide the missile straight down range until impact.

11-37. Missile Assembly, Installation, and Disassembly

a. General Precautions.

Warning: All personnel must observe the following precautions when handling missiles.

(1) Remove all rings and jewelry from hands before assembling, installing, or disassembling missiles.

(2) Do not install missiles on the helicopter until the daily operational checks have been successfully completed.

(3) Do not mount missiles until the helicopter has been fueled, checked out, and is ready for flight.

(4) For the person in charge of installing the missiles, be sure he has the missile selection box key in his possession.

(5) Always approach or move away from missiles at a right (or left) angle to the line-of-fire.

(6) Be sure that all persons not actively engaged in installing the missiles remain at least 100 meters from the launchers and clear of the flightpath.

(7) Position helicopter in an open area with missiles pointing toward a safe, uninhabited area.

(8) Mount missiles from the inside launcher to the outside, both left and right.

(9) See that the explosive bolt cables are connected to their shorting plugs until just before helicopter takeoff.

(10) Never assemble missiles within 300 meters of a radio or radar installation that has more than 100 kw of peak power.

b. Missile Assembly and Installation.

(1) Pilot.

(a) Check each fixed housing to make sure the explosive bolt cable is connected to the shorting plug. Leave fixed housing hinged cover open.

(b) Check front and rear guiderails on each launcher for damage.

(2) Gunner.

(a) Check SS-11 MISSILE POWER and SS-11 MISSILE JETTISON circuit breakers on overhead panel and make sure they are in off (pulled out) position.

(b) At the helicopter pedestal console, insure that SS-11 JETTISON switch (fig 11-71) is set in the SAFE position.

(c) Set missile selection switch on missile selection box at the O position.

(d) Make sure key switch is in off position and key is removed. Retain key until firing is to commence.

(e) Check firing switch on guidance control unit and make sure it is in "O" position.

(3) Pilot.

(a) Press and turn the two turnlock fasteners securing the battery compartment cover on the missile shipping container and remove the special wrench inside.

(b) Remove the spring clips that hold the toggle fasteners and, using the special wrench, release the eight fasteners holding the container halves together.

(c) Lift the top half of the container and place it upside down on the ground.

(4) Gunner.

(a) Using the missile battery tester, place the battery, rounded side forward, on the connector pins of the tester. The voltmeter should indicate between 12 and 15 volts.

(b) Press the toggle switch on the tester in either direction and hold. As soon as indication is read on meter, release the toggle switch. The voltmeter indication should not differ more than 1.5 volts from the indication obtained in (a) above, and total voltage should not be less than 12 volts.

(c) Repeat steps in (a) and (b) above for second battery.

(5) Pilot and gunner.

(a) Inspect the condition of the detonator arming device, located in the front portion of the missile body. The top of the arming piston should not be seen protruding above the surface of the rim.

Warning: If the arming device is found to be armed, do not move the missile. Evacuate the area and call EOD personnel.

(b) Remove the clamps that hold the missile body in the container, and, with the pilot at the front and gunner at the rear, lift the missile and place it on the launcher by carefully aligning the top mounting lug ears with the launcher rails. DO NOT fully seat the missile.

Note. Two men are required to handle the missile. Do not grasp the junction box when mounting on the launcher.

(c) After the gunner removes the dust cover and clamps from the junction box connector plug, rearward pressure is exerted on the missile by the pilot while the gunner carefully aligns the junction box connector plug with the launcher plug receptacle. Fully seat the missile body on the launcher, insuring that the guillotine lock on the launcher engages the prongs of the junction box.

(6) Pilot.

(a) Remove the explosive cartridge from its receptacle in the missile shipping container.

(b) Remove the plastic shorting plug from the rear of the explosive cartridge cap.

(7) Gunner.

(a) Unscrew the protective plug from the missile battery circuit tester port.

(b) Short out the circuit by inserting a screwdriver into the port. If the batteries are properly seated in the missile, the jet deflectors will make an audible clicking sound.

Note. If jet deflectors do not click, remove warhead as described in *c* below (disassembly). Reseat the batteries and reinsert the screwdriver. If click is not heard, recheck batteries on battery tester and replace if necessary. If, after again seating both batteries, no clicking is heard, follow remaining disassembly steps in *c* below. If clicking sound is heard, reinstall the warhead as before and recheck the circuit.

(8) Pilot.

(a) Grasping the launcher locking lever handle, pull up and at the same time exert downward pressure on the locking hook.

(b) After cartridge is seated, release both handle and hook so gunner may recheck seating.

(9) Gunner.

(a) Take explosive cartridge and insert into launcher receptacle, making sure molded ridge on explosive cartridge cap is aligned with painted tick mark on outside of receptacle.

(b) Make sure explosive cartridge locking pin on side of launcher receptacle is engaged.

(c) Check the cartridge to insure that it is properly seated by pulling out on it. It should not pull out.

(d) Cut the plastic bands around the igniter wires on the missile flares to insure that guidance wires do not become entangled in the flare caps upon missile launch.

(10) Pilot.

(a) Remove the three retainer straps on the warhead, and remove from upper half of missile shipping container.

(b) Remove the plastic container inclosing the warhead, being careful in handling the high explosive head.

Note. The ATM-22B (inert) does not have the plastic container for the warhead.

(11) Gunner.

(a) By hand, remove the detonator protective cap, being careful not to strike the detonator. If it cannot be removed by hand, use a wooden stick as a lever to loosen the cap.

(b) Place the two missile batteries in their proper clamps, making sure they are firmly seated.

(c) Take the warhead and screw it onto the missile body, taking care not to strike the detonator. Screw the head up tight, back it off one-quarter turn, and then give it a rapid twist to properly seat the warhead.

(12) *Pilot and gunner.* Repeat steps (3) through (11) above for each missile to be mounted.

(13) Pilot.

(a) Hold outboard end of launcher support assembly while gunner removes locking pin, and then check for security.

(b) Assume pilot's duties.

(14) Gunner.

(a) With one hand under inboard end of launcher support assembly, remove locking pin holding launcher support assembly to housing assembly. If there is "end play" in launcher support assembly, tighten actuator shaft.

(b) Record serial numbers of mounted missiles and the launcher upon which each missile is mounted.

(c) Just prior to helicopter takeoff, connect all explosive bolts to the system and secure hinged covers.

c. Missile Disassembly.**(1) Pilot.**

(a) Insert locking pin in launcher support assembly/housing assembly.

(b) Check each fixed housing and connect all explosive bolts to their shorting plugs. Leave fixed housing hinged covers open.

(2) *Gunner.* Take steps as outlined in *b*(2) above.

(3) Gunner.

(a) Unscrew the warhead from the missile body, being careful not to strike the detonator.

(b) Inspect the condition of detonator arming device.

Warning: If found armed, evacuate the area and call EOD personnel.

(c) Remove the two missile batteries.

(d) Replace the detonator protective cap.

(4) Pilot.

(a) Replace warhead in plastic shell.

(b) Put warhead back into upper half of missile shipping container and secure with the three straps provided.

(5) *Pilot and gunner.* With the pilot pulling up on the launcher locking lever handle and out on the locking pin, the gunner pulls out the explosive cartridge.

(6) *Pilot.*

(a) Replace the plastic shorting plug on the explosive cartridge cap and place the cartridge in its plastic container. Place the container in the missile shipping container receptacle, taking care that the serial number on the side of the shipping container matches that of the missile being disassembled.

(b) Prepare the shipping container to receive the missile body and warhead.

(7) *Pilot and gunner.* With the pilot at the front of the missile, the gunner will push up on the guillotine lock and forward on the junction box to disengage the connector plug. Avoid letting the missile go too far forward, since the mounting lugs could come out of the rails and the missile fall to the ground.

Note. If the missile is pushed or pulled forward without the junction box connector plug being disengaged, the junction box will separate from the missile and may render the missile unusable for future firings.

Warning: The junction box contains explosives, and if it separates from the missile and drops, the concussion could cause detonation.

(8) *Gunner.* Replace dust cover and clamps on the junction box connector plug.

(9) *Pilot and gunner.*

(a) Remove the missile from the launcher rails and place it in missile shipping container.

(b) Secure retainer clamps.

(c) Mate upper half of shipping container to lower half.

(d) Fasten the eight toggle fasteners on the missile shipping container, and insert the spring clips in the fasteners.

(e) Replace special wrench in container battery compartment.

(10) *Pilot and gunner.* Repeat steps (3c) through (9) above for all missiles to be disassembled.

d. Disassembly of M22 External Hardware.

(1) *Launcher.*

(a) *Pilot.* Check to make sure explosive cartridge has been removed and inert tagged cartridge inserted in launcher explosive cartridge receptacle.

Note. Explosive cartridge is ammunition and should be handled as such. For proper storage, see TM 9-1300-206.

(b) *Gunner.* Check to make sure explosive bolt cable is connected to shorting plug.

(c) *Pilot.* Hold launcher in position.

(d) *Gunner.* Remove nut from explosive bolt and help pilot to remove launcher by moving it straight down, being careful not to damage explosive bolt or electrical connections.

(e) *Gunner.* Check launcher for cleanliness and proper lubrication at pivot of the locking hook, locking lever handle, and guiderails. If needed, lubricate using GL grease MIL-G-3278.

(2) *Fixed housing.*

(a) *Gunner.* If extra plug is not available, remove explosive bolt from fixed housing and shorting plug. Check cable for frayed or broken shielding. Replace nut which was removed to take off launcher. Replace screws on bolt mounting (these are metric size and hard to obtain in the United States).

Warning: Explosive bolt is ammunition and should be treated as such. For proper handling and storage, refer to TM 9-1300-206.

(b) *Pilot.* Disconnect cables leading from launcher support assembly and remove from fixed housing.

(c) *Pilot.* Hold fixed housing in position.

(d) *Gunner.* Remove U-bolts and help pilot to remove fixed housing. Replace U-bolts and inspect for cleanliness. Check wiring harness for frayed insulation.

(3) *Launcher support assembly.*

(a) *Pilot.* Make sure locking pin is inserted on both sides of aircraft, and then move pilot's mechanical jettison lever to the full rear (unlocked) position.

(b) *Gunner.* Remove actuator shaft latch and turn actuator shaft clockwise until loose.

(c) *Pilot.* Secure outboard end of launcher support assembly.

(d) *Gunner.* After securing inboard end of launcher support assembly, pull locking pin out and disconnect cable from housing assembly. Check condition of wiring harness.

11-38. Target Acquisition and Firing Technique

a. General. The target may be engaged at any range between 500 and 3,500 meters (the maximum range dependent upon the mode in which the missile is fired). Tactical as well as terrain considerations will dictate at what range the attack will commence. The size and silhouette of the target will determine the angle of fire. The gunner's remaining consideration is use of the antioscillation sight.

b. Not Using the Sight. The difficulties of target acquisition and firing without use of the sight in-

crease with range. The advantage of firing by naked eye is that the pilot need not remain on an inbound course after launch, but can take small evasive maneuvers in both the lateral and vertical planes. However, the gunner must keep the missile flares between him and the target. Evasive maneuvers, however small, increase the gunner's difficulty in accomplishing this task. This is because his angle of vision changes with every deviation from a collision course. A disadvantage of firing by naked eye is an unclear view of the target because of range. When the edges of the target are poorly defined, the center of mass is hard to determine and the gunner has trouble placing the missile flares in the middle of the target area. This often results in near misses, either laterally or vertically. Also, when firing at ranges in excess of 2,500 meters and without the benefit of a magnified view of the target and missile, the smoke from the missile sustainer motor may be enough to obscure both the missile flares and the target. The method of firing is to—

(1) Estimate the range to get an estimate of missile flight time. Below are approximate flight times for ranges given.

500 meters—5 seconds
 1,000 meters—9 seconds
 1,500 meters—12 seconds
 2,000 meters—15 seconds
 2,500 meters—18 seconds
 3,000 meters—20 seconds
 3,500 meters—22 seconds

(2) Launch the missile, then initiate command control at the first opportunity to determine the individual missile's reaction to a given command; i.e., whether its reaction is normal, sensitive, or sluggish.

(3) Bring the missile in a gentle arc over to the vertical centerline of the target (but not beyond), and approximately three target widths above the target. Stabilize the missile in this position.

(4) With about 5 seconds remaining of missile flight time to target, lower the missile slowly on the vertical centerline to the target horizontal centerline, being careful not to go below that line.

(5) Stabilize the missile on the center of mass and await impact.

c. Use of the M55 (Gunner's Sight). The M55 sight can be used to great advantage while firing from a static position, or from any mode when the helicopter is equipped with yaw stabilization (AN/ASW-12). The obvious advantage in using the M55 sight is the magnified view of the target

and missile. Poor visibility due to range or natural causes (fog, haze, light rain, etc.), or the smoke of the missile, is reduced. The M55 sight cannot be successfully employed in any mode other than static without yaw stabilization. This is due to the narrow field of vision inherent in the use of an instrument of magnification, which results in the inability to keep the target and missile in sight. Use of the sight is restricted to targets beyond 1,000 meters range. When the range of the target is less than 1,000 meters, the speed of the missile does not allow the average gunner time to stabilize the missile, transition to the sight, and guide it to the target. The method of firing is to—

(1) Estimate range to get an estimate of missile flight time.

(2) (Pilot) Establish the helicopter on a heading toward the target, with the target centered in the Mk 8 sight, and engage the AN/ASW-12 heading lock by pressing forward and releasing the beep switch on the cyclic control. This locks the helicopter on the precise heading on which it was established.

(3)—(4). Same as *b*(2), (3) above.

(5) Transition to the binoculars, and upon firm sighting of the target and missile, lower the missile slowly on the vertical centerline to the target horizontal centerline, being careful not to go below that line. Stabilize the missile on the center of mass and await impact.

(6) (Pilot) For a moving target, track by use of the flat rate turn control dial and the AN/ASW-12 beep switch, being careful to keep the target centered in the Mk 8 sight.

d. Use of the XM58 (Gunner's) Sight. The XM58 sight eliminates the disadvantages of firing with the naked eye and firing using the M55 sight and combines their advantages. As long as evasive maneuvers are within 45° of centerline in azimuth and plus or minus 15° in elevation, the pilot may make evasive maneuvers while the gyro stabilization keeps the target and missile centered in the sight. However, evasive maneuvers increase the difficulties of the gunner using the XM58 sight, as similar maneuvers do when firing without a sight. Because of the unobstructed view of the left eye of the gunner, launch to impact can be observed without leaving the sight. Also because of the magnified monocular vision available to the right eye of the gunner, magnified view of the target is seen by the gunner at all times and at all ranges. The method of firing is—

(1) Estimate range to get an estimate of missile flight time.

(2) By the gimbal position control or by hand, establish sight on target in azimuth and elevation until sight is stabilized in the proper position.

(3)—(4). Same as *b*(2), (3) above.

(5) Stabilize the missile on the center of mass and await impact.

(6) (Pilot) Use the line-of-sight indicator on the instrument panel to keep the helicopter within the 45° azimuth limitations, and use the Mk 8 sight to keep within the 15° elevation limit.

(7) (Gunner) Track a moving target with the gimbal position control.

Section IV. XM26 (TOW) ARMAMENT SUBSYSTEM

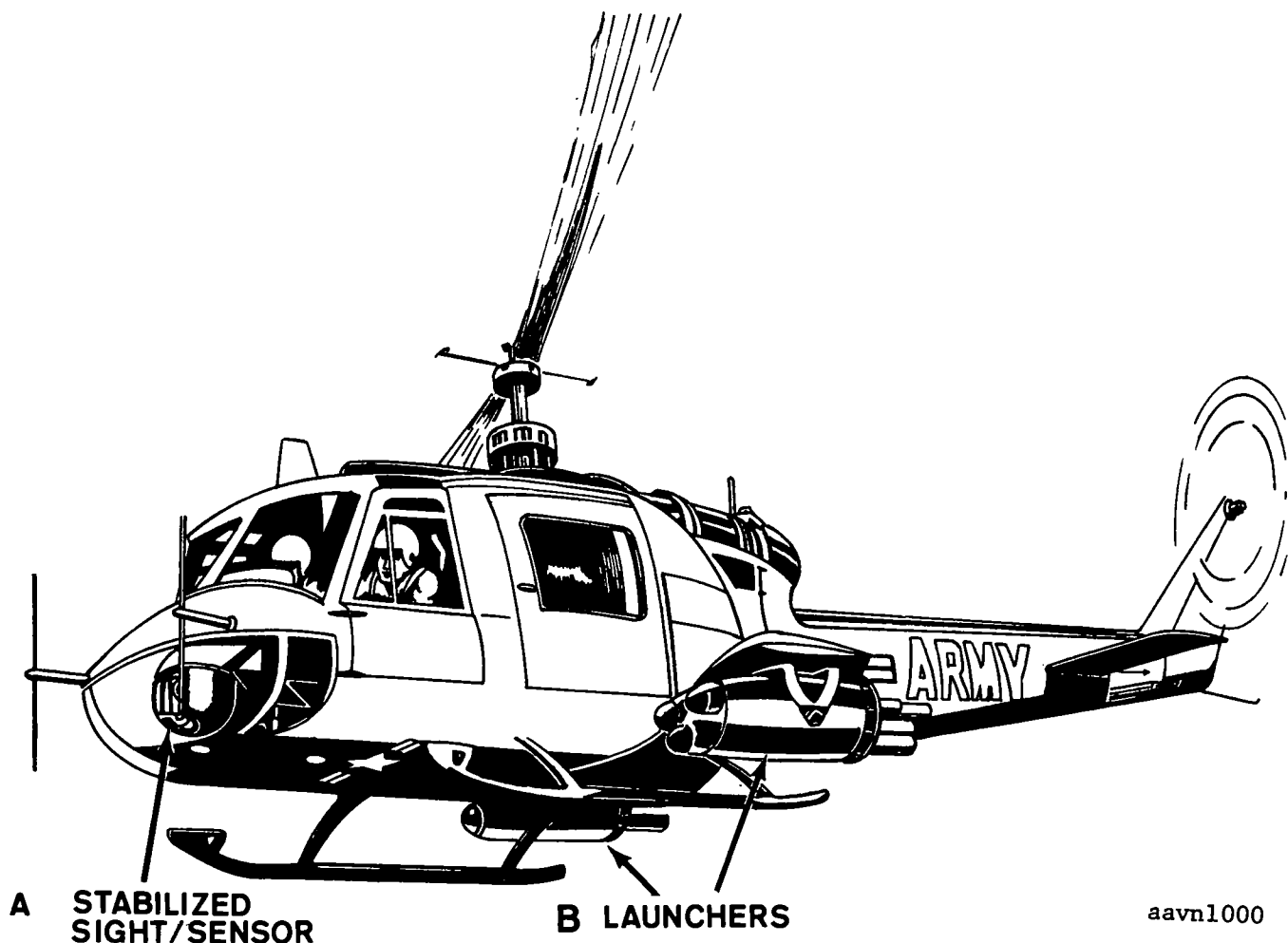
11-39. Description

The purpose of the XM26 (TOW) helicopter armament subsystem (fig 11-79) is to provide the Army with a highly mobile, airborne, heavy point fire weapon system. This system uses the TOW (tube launched, optically tracked, wire command link) guided missile. The XM26 is designed to replace the M22 subsystem. It consists of the following major assemblies—

a. Stabilized Sight/Sensor. The stabilized sight/sensor (A, fig 11-79) mounted in the heli-

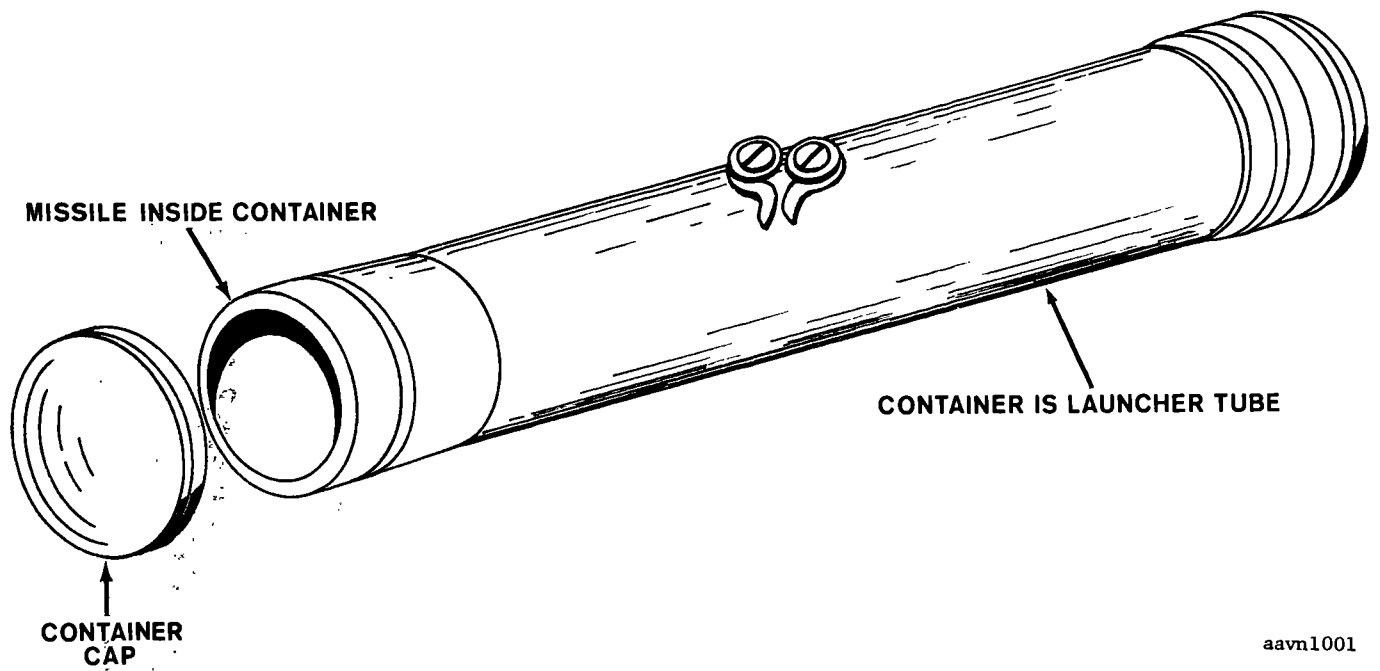
copter nose is the key to the XM26 subsystem. This gyro-stabilized sight enables the gunner to keep the crosshairs of his sight on the target, regardless of helicopter vibration and maneuvers. Through the sight, the gunner establishes and maintains the line of sight which the missile follows to the target.

b. Launchers. The missile container is attached to the helicopter bomb rack. There is a launcher containing three missiles (B, fig 11-79) on each side of the UH-1B/C/M helicopter. The launchers



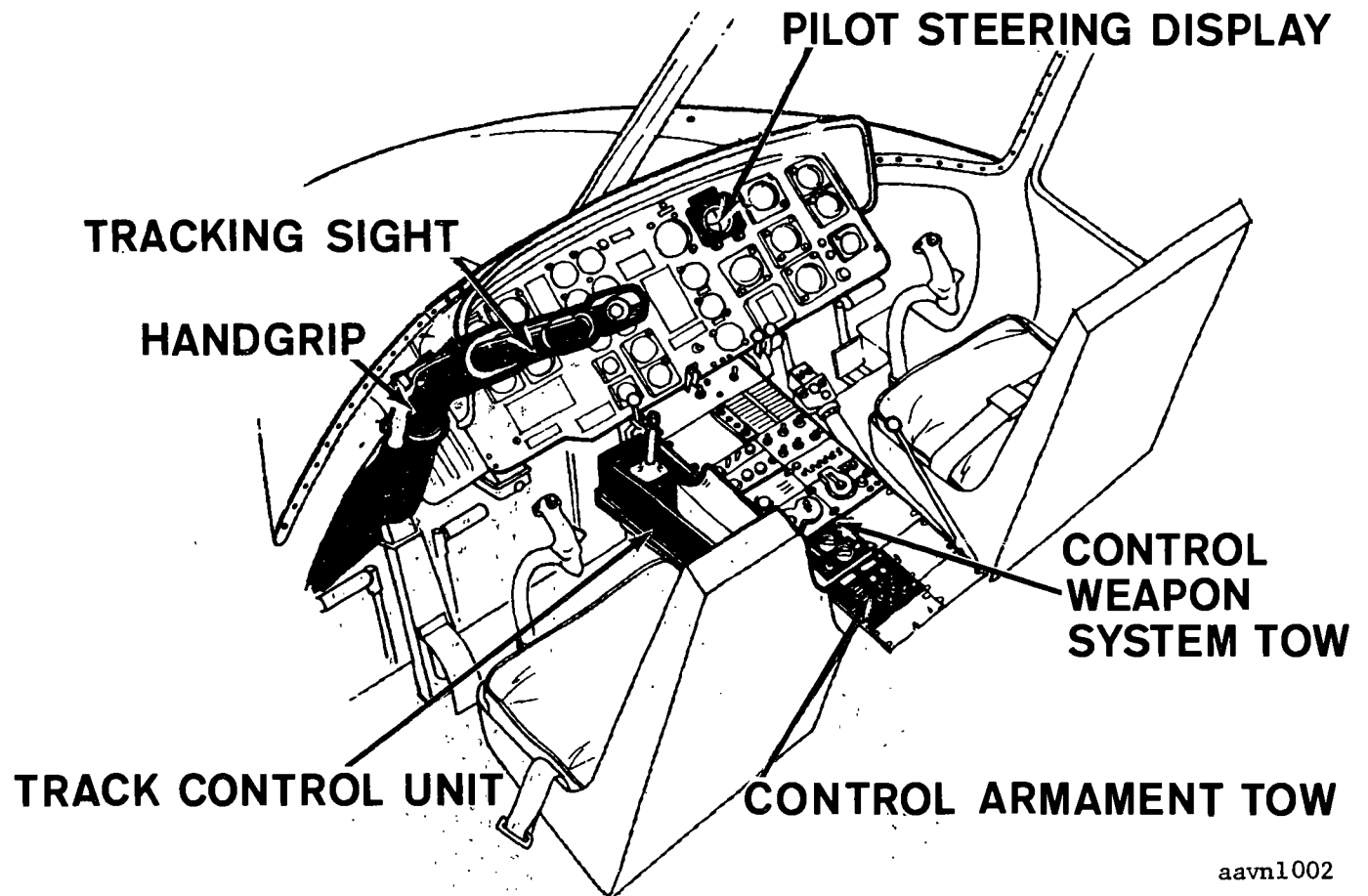
aavn1000

Figure 11-79. XM26 armament subsystem on UH-1B/C/M.



aavn1001

Figure 11-80. Missile and container.



aavn1002

Figure 11-81. Cockpit controls and displays in UH-1B/C/M helicopter.

are movable in elevation only by hydraulic actuation.

c. *Electronics.* The electronic assemblies contain necessary circuitry for the operation of all XM26 subsystem assemblies. The circuitry is built into three separate chassis—*servo electronics*, *auxiliary electronics*, and *command signal generator*.

d. *Power Supply.* Power for the subsystem is produced through an inverter located in the helicopter engine compartment. The inverter uses 24 volts DC from the helicopter emergency power and converts it into 115 volts AC 400 cycle, three-phase power for the XM26 subsystem. If emergency power is needed as helicopter prime power, the circuit is designed so that the XM26 subsystem can be switched out of the circuit.

e. *Missile.* The TOW missile round is launched directly from the missile container (fig 11-80), without an additional launch tube.

f. *Cockpit Controls and Displays.* The cockpit controls and displays located in the cockpit allow for ease of operation by the gunner and do not interfere with the flight controls of the helicopter. Figure 11-81 shows cockpit controls and displays in a UH-1B/C/M helicopter; however, the XM26 subsystem is adaptable to the AH-1G attack helicopter. Power and armament controls are mounted on the console between the pilot's and gunner's seats. These are within easy reach of both pilot and gunner. Additional controls and displays are located on the sight extension tube,

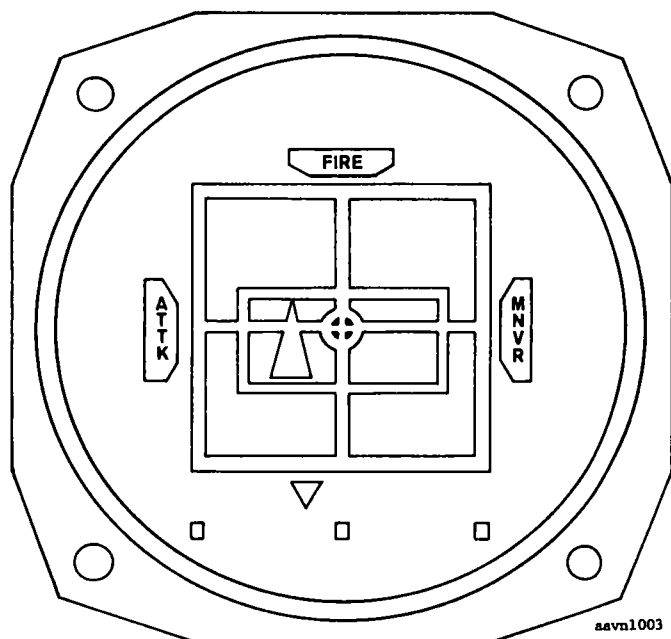


Figure 11-82. Pilot steering display.

gunner's armrest, and the helicopter instrument panel.

(1) *Pilot steering display.* The pilot steering display (fig 11-82) provides attack status data and an azimuth steering signal for missile firing. So that the pilot will not exceed the gimbal angle limits during maneuvering flight, it indicates platform gimbal angles.

(2) *TOW armament subsystem control panel.* The TOW armament subsystem control panel (fig 11-83) has—

(a) *SAFE/ARMED switch.* When this switch is placed in the SAFE position, a missile cannot be fired; when placed in the ARMED position, it completes the circuitry necessary for firing a missile.

(b) *MISSILE SELECT switch.* Missile selection can be manual or automatic by means of the MISSILE SELECT switch. When placed in the AUTO position, the system will select the next ready missile. Each position on the switch has a flag indicator that will indicate the presence (MSL), or absence (barber pole) of the selected missile.

(c) *JETTISON switches.* In an emergency, activation of the JETTISON switches jettisons the launcher assemblies to improve helicopter maneuverability.

(d) *EMERGENCY WIRE CUT.* In case of wire entanglement or failure of the automatic wire cutting device, the emergency wire cut control permits the gunner to cut the wire.

(3) *TOW weapon subsystem control panel.* The TOW weapon subsystem control panel (fig 11-84) has—

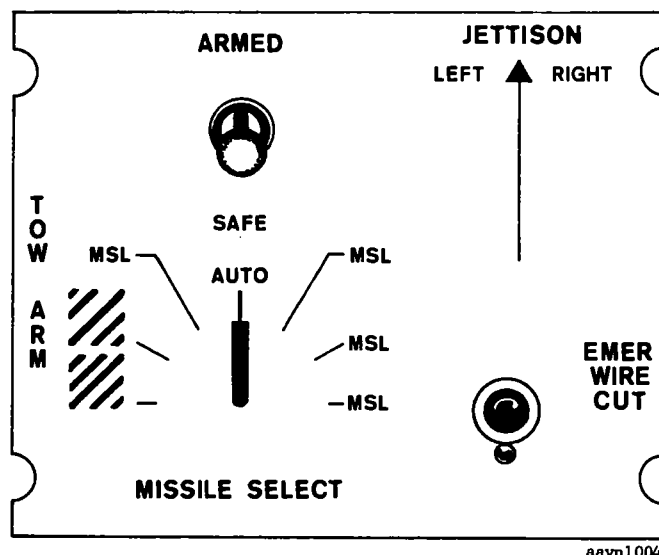


Figure 11-83. TOW armament subsystem control panel.

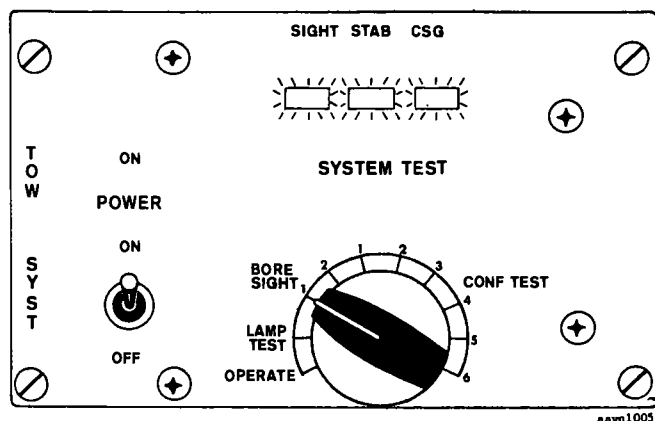


Figure 11-84. TOW weapon subsystem control panel.

(a) **POWER ON/OFF switch.** In the ON position, full operating power is applied to the subsystem.

(b) **SYSTEM TEST switch.** This 10-position switch is used to determine the operational status of the weapon subsystem. The first position (OPERATE) switches out all system test circuitry; the switch must be in this position to fire a missile. The second position (LAMP TEST) applies power to all indicator lamps. The next two positions (B1 and B2) are used in performing boresighting checks and alignment. The last six positions of the switch are used to perform system selftest. Results of the selftest are indicated on the three flag indicators above the switch. A GO indication will be displayed when a particular test has been satisfactorily completed. The three indicators used are—SIGHT, for the stabilized sight/sensor unit; STAB, for stabilization electronics; and CSG, for missile guidance electronics.

(4) **Track control unit.** The track control unit (fig 11-85) is designed for right-handed operation by the gunner to provide control inputs to the TOW sight system for manual acquisition, tracking, and stow positioning of the sight. The tracking control stick and control switch have been designed into a small unit separate from the armrest. The position of the control unit may be adjusted to accommodate different sized gunners.

(5) **Gunner's handgrip.** The gunner's handgrip (fig 11-86) provides a means of stabilization for the gunner, switching function controls, and a designation pointer display. The handgrip is fixed to the left side of the sight unit relay column near the upper rotary joint. The switching functions are short or long range selection, high or low magnification selection, camera control, reticle brightness control, attack mode selection, and trigger. The trigger is a recessed, momentary, snap-action

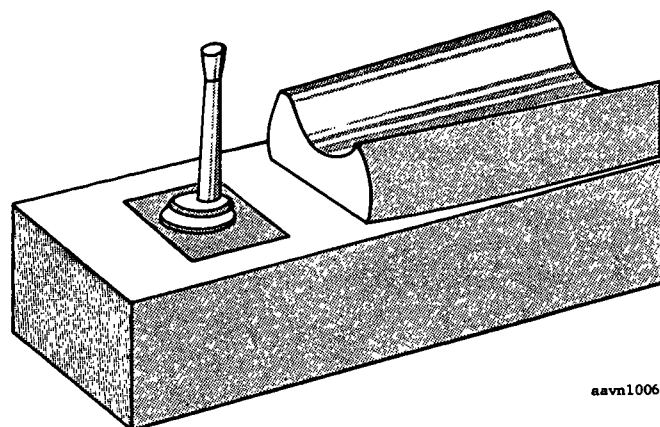


Figure 11-85. Track control unit.

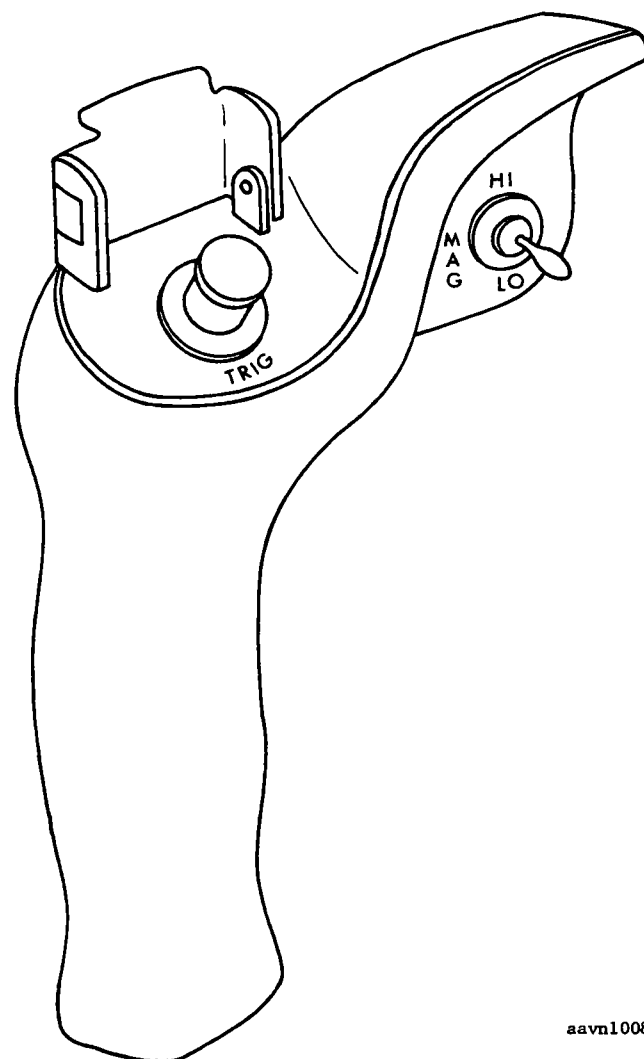


Figure 11-86. Handgrip.

pushbutton. The designation pointer display is a small pencil-shaped pointer that indicates where the sight is pointing. It is used in the heads-up mode for gross positioning of the sight prior to

heads-down acquisition. It is located over a moving card display that indicates the azimuth position of the sight relative to a fixed scale.

11-40. Operation

a. In combat, the helicopter gunner acquires and tracks a target through the stabilized sight/sensor. A display on the instrument panel (fig 11-82) will indicate to the pilot each phase of the engagement; e.g., attack, fire, and maneuver. Also indicated are limitations of the evasive maneuvers that the pilot may perform.

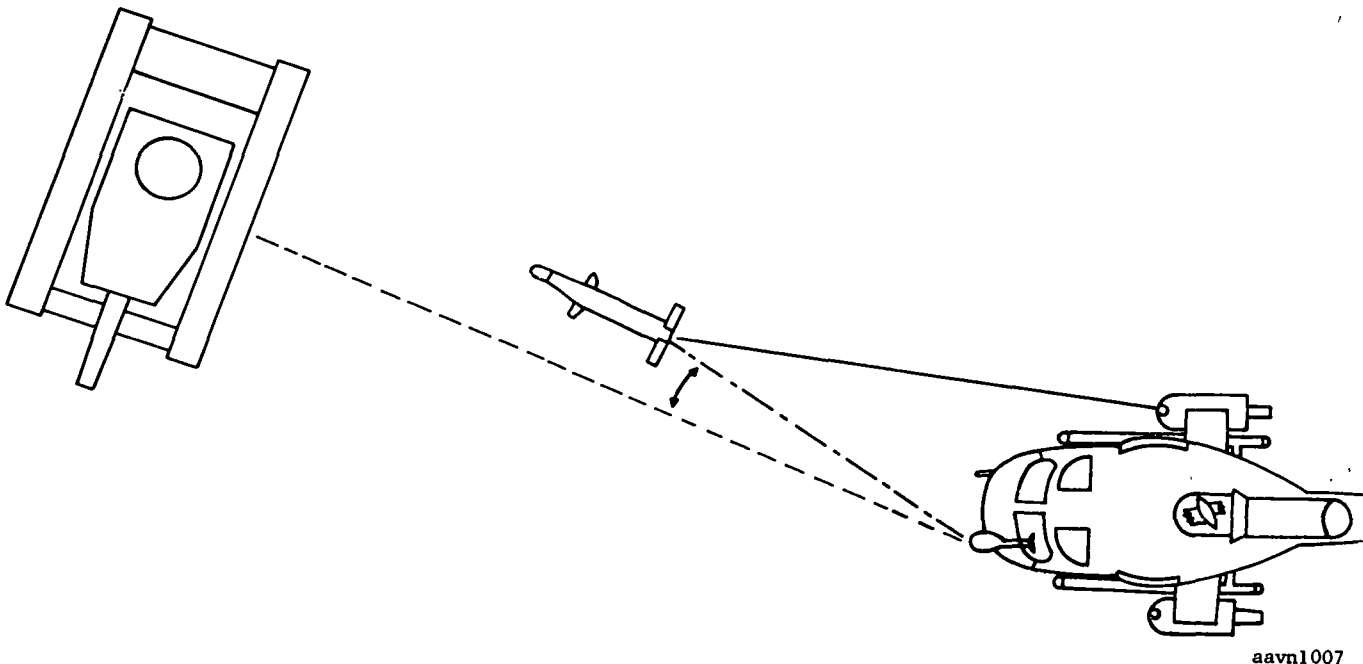
b. Easily operated, viscous damped controls (fig 11-85) enable the gunner to maintain the sight/sensor pointing direction without regard to the angular motion or vibration of the helicopter.

c. The TOW missile is fired into the field of view of the stabilized sight/sensor. The stabilized

sight/sensor "senses" missile flightpath deviation from the line of sight maintained by the gunner. These deviations are sent (in terms of electronic impulses) to the command signal generator, then converted into corrective command and sent to the missile by thin wires that are payed out in flight. These corrective commands guide the missile back to the line of sight and on to the target (fig 11-87).

11-41. Logistical Support

TOW armament subsystem equipment will be designed to include a completely built-in selftest capability that will isolate faults down to a removable major assembly. Under the current planned concept, the aircraft armament repairman will remove and replace the defective assembly indicated by the built-in selftest.



aavn1007

Figure 11-87. Weapon concept.

CHAPTER 12

AH-1G ARMAMENT SUBSYSTEMS

Section I. M28A1 ARMAMENT SUBSYSTEM

12-1. Description

The M28A1 armament subsystem (fig 12-1—12-5) is a dual-weapon, hydraulically and electrically operated subsystem. It is gunner controlled as a fully flexible weapons system and pilot controlled as a fixed system (in a forward, stowed, position). Any one of the following combination of weapons may be used: left M134 machinegun, and right M129 cartridge launcher (fig 12-1); left M129 cartridge launcher, and right M134 machinegun (fig 12-2); two M134 machineguns (fig 12-3 and 12-4); or two M129 cartridge launchers (fig 12-5).

12-2. Operation

The subsystem consists essentially of the following major components: M134 machinegun accessory assemblies, M129 cartridge launcher accessory assemblies, helicopter weapon turret and chute separator assembly, weapons gun speed and launcher brake controllers (left and right), intervalometers, electronic components assembly, differential pressure transducer, helicopter turret sighting station and stow bracket assembly, gunner's control panel, pilot's wing stores control panel, pilot's control panel, and reflex sight M73.

a. M134 Machinegun Accessory Assembly. The M134 machinegun accessory assembly (fig 12-6) stores and transports the ammunition from the ammunition compartment to the gun rotor, fires the rounds, and ejects the links and cartridge cases. The accessory consists primarily of the machinegun, the machinegun drive assembly, delinking feeder (MAU-56/A), ammunition chute, flexible shaft assembly, and ammunition storage containers. The ammunition storage containers may be either the ammunition box assemblies with crossover assembly or the ammunition magazine assembly.

(1) *M134 machinegun.* The M134 machinegun is an electrically-driven, automatic, air-cooled multibarrel gun incorporating six barrels and six bolt assemblies which revolve around the longitudinal axis of the weapon. The M134 machinegun

is capable of firing 6-second bursts at rates of 2,000 rounds per minute or 4,000 rounds per minute.

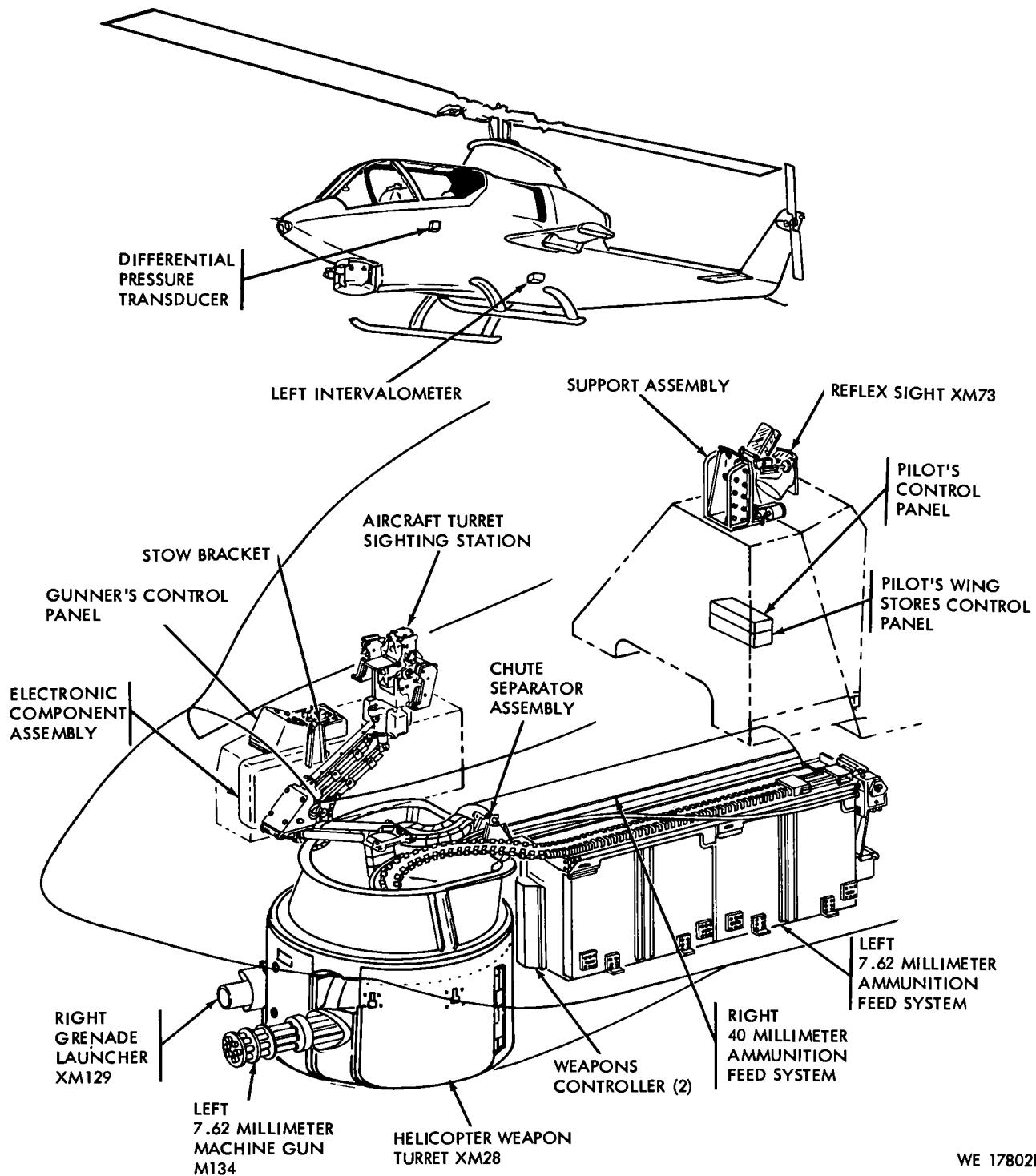
(2) *Machinegun drive assembly.* The machinegun drive assembly includes the electric motor, gear reduction housing assembly, and feed drive gearbox. The electric motor is a two-speed, 24-volt direct current motor. The motor provides 1.7 horsepower at high speed and 0.75 horsepower at low speed to operate the gear reduction housing assembly and feed drive gearbox. The gear reduction housing assembly, mounted on the forward side of the electric motor, is used to drive the machinegun and provide a mounting point for the drive assembly. The feed drive gearbox, mounted on the rear of the electric motor, provides the necessary gearing to drive the flexible shaft assembly. In turn the shaft assembly operates either the crossover assembly or the ammunition magazine assembly.

(3) *Delinking feeder (MAU-56/A).* The delinking feeder (MAU-56/A) is gear driven through the machinegun. The feeder removes the cartridges from the links and feeds them to the bolt and track assemblies in the machinegun rotor. The links are discarded through the link ejector chute attached to the feeder.

(4) *Ammunition chute.* The ammunition chute is a flexible link channel which guides the ammunition from either the crossover assembly or the ammunition magazine assembly to the feeder mounted on the machinegun. The left and right ammunition chutes are functionally the same, but physically different, and are not interchangeable.

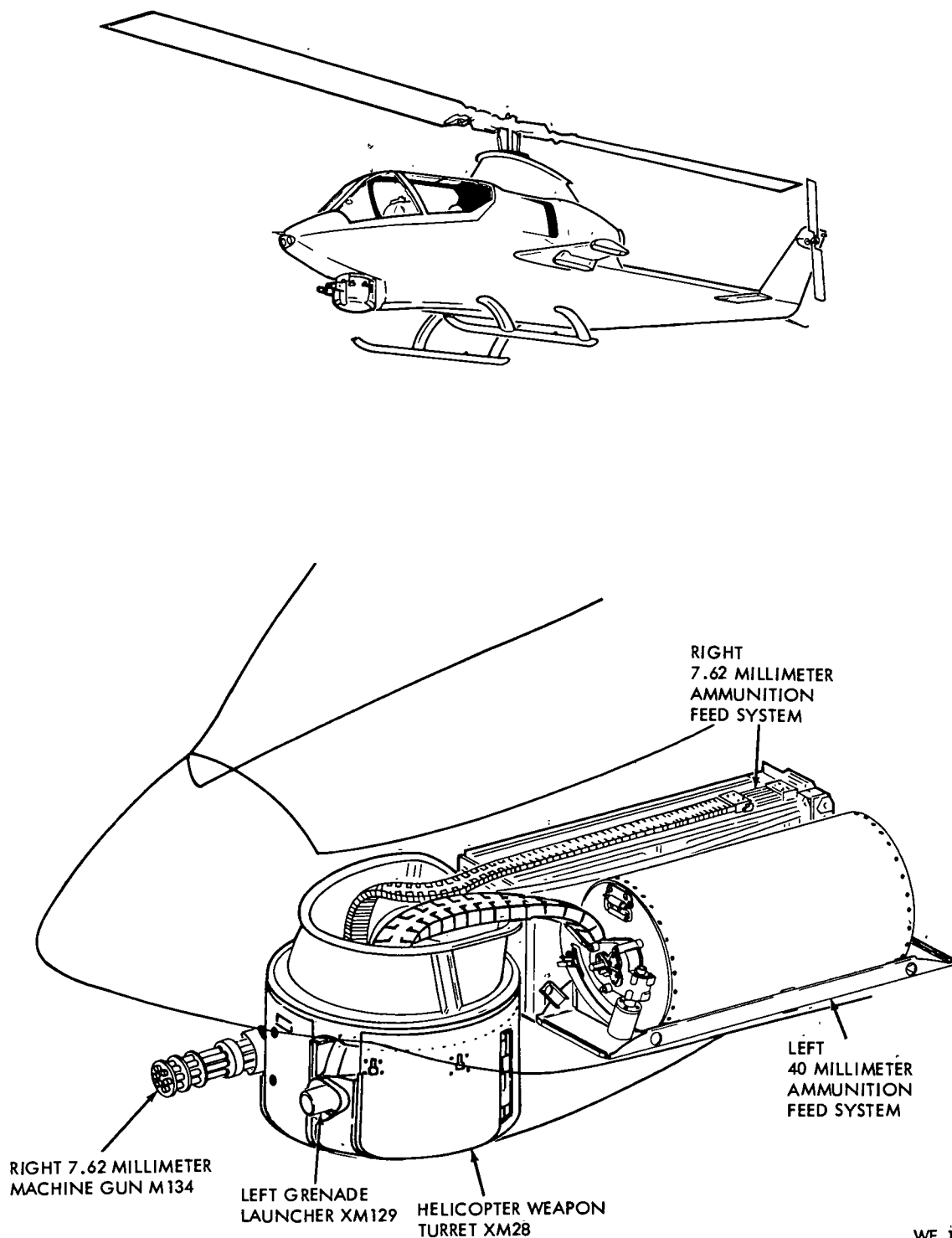
(5) *Flexible shaft assembly.* The flexible shaft assembly mechanically connects the machinegun drive assembly to either the crossover assembly or the ammunition magazine assembly.

(6) *Ammunition storage containers.* The two ammunition box assemblies are located in the ammunition compartment, aft of the turret. The ammunition box assemblies are locked together and have a capacity of 4,000 rounds of linked ammunition.



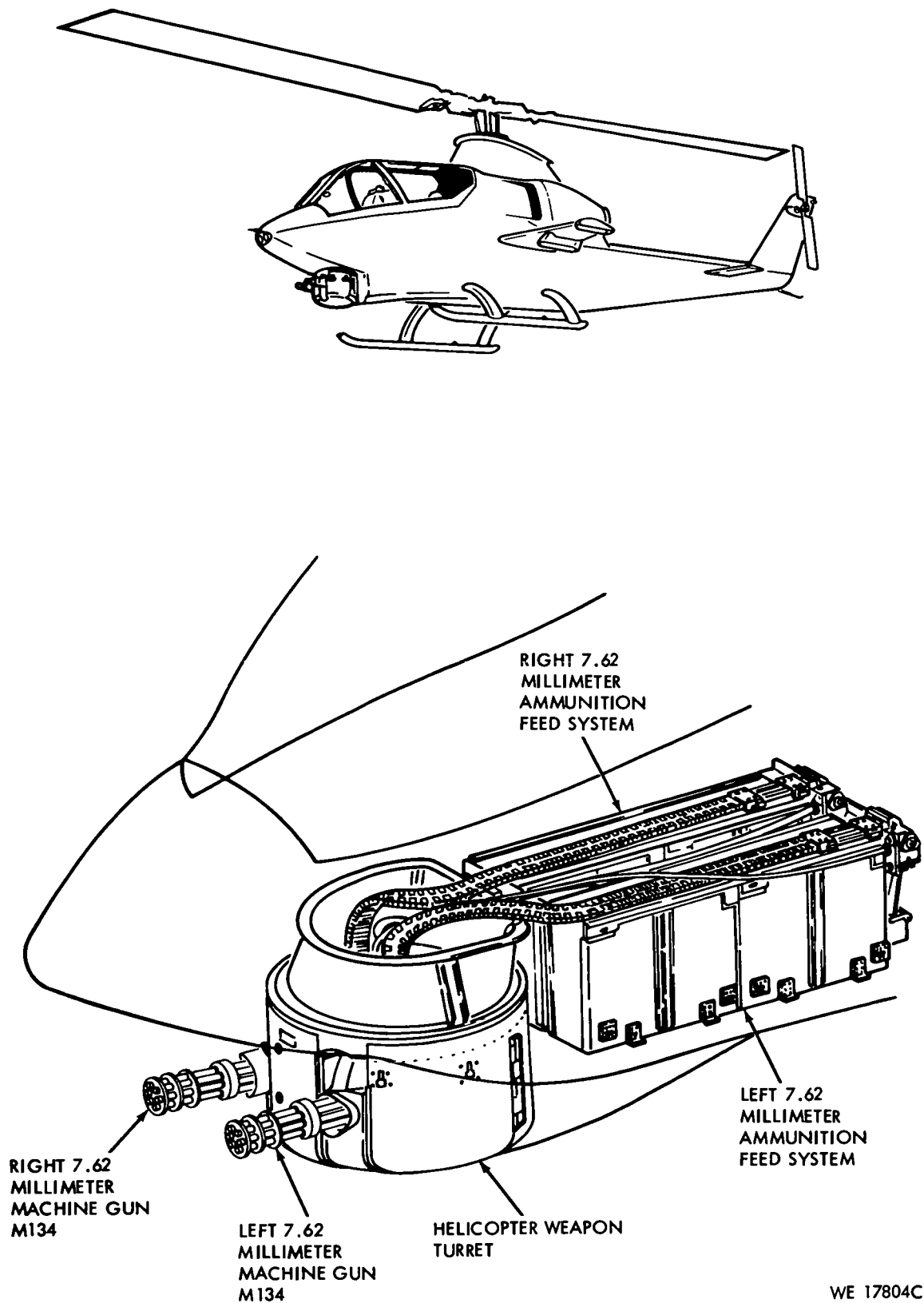
WE 17802D

Figure 12-1. Left M134 machinegun and right M129 cartridge launcher.



WE 17803A

Figure 12-2. Left M129 cartridge launcher and right M134 machinegun.



WE 17804C

Figure 12-3. Two M134 machineguns with ammunition box assemblies.

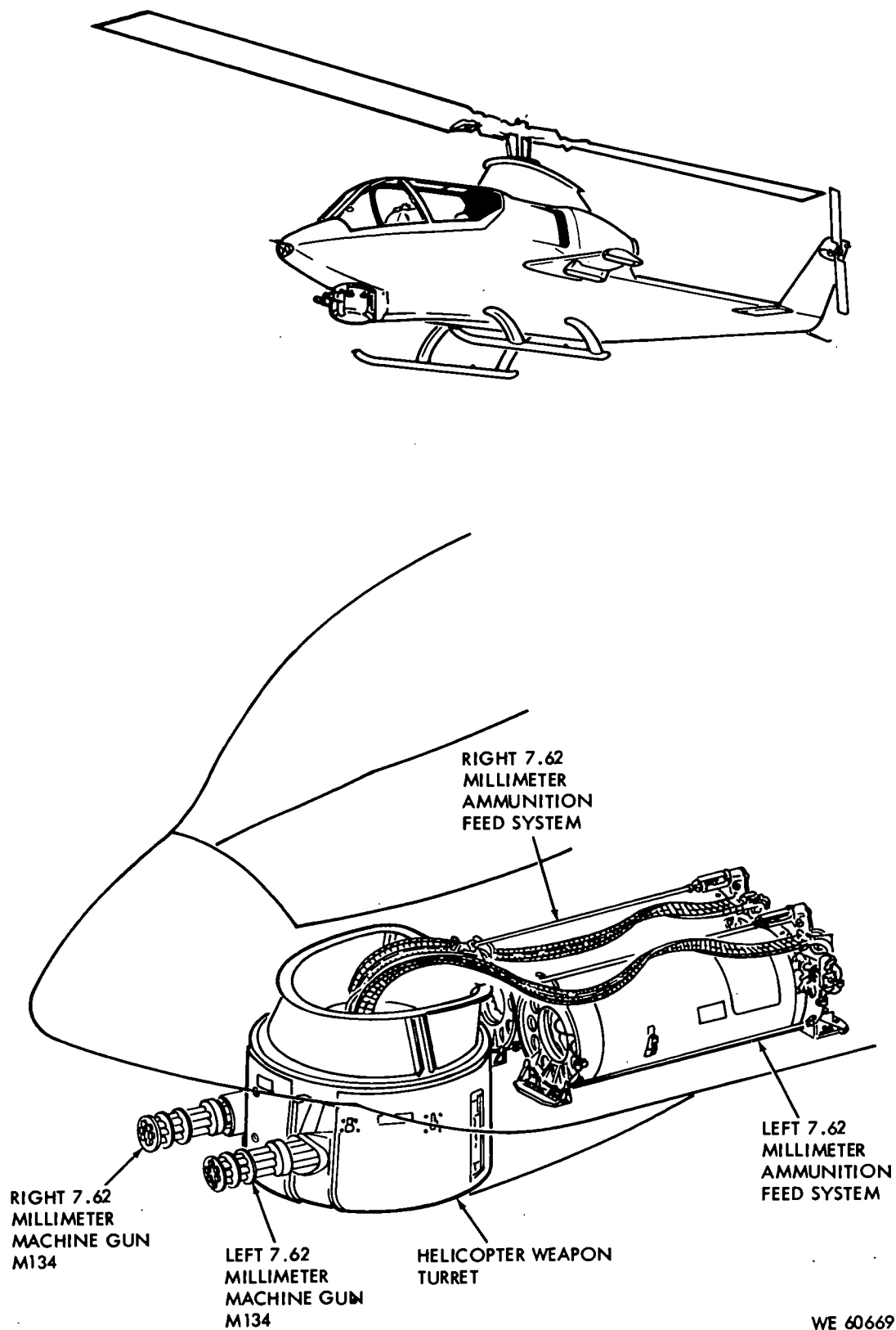


Figure 12-4. Two M134 machineguns with ammunition magazine assemblies.

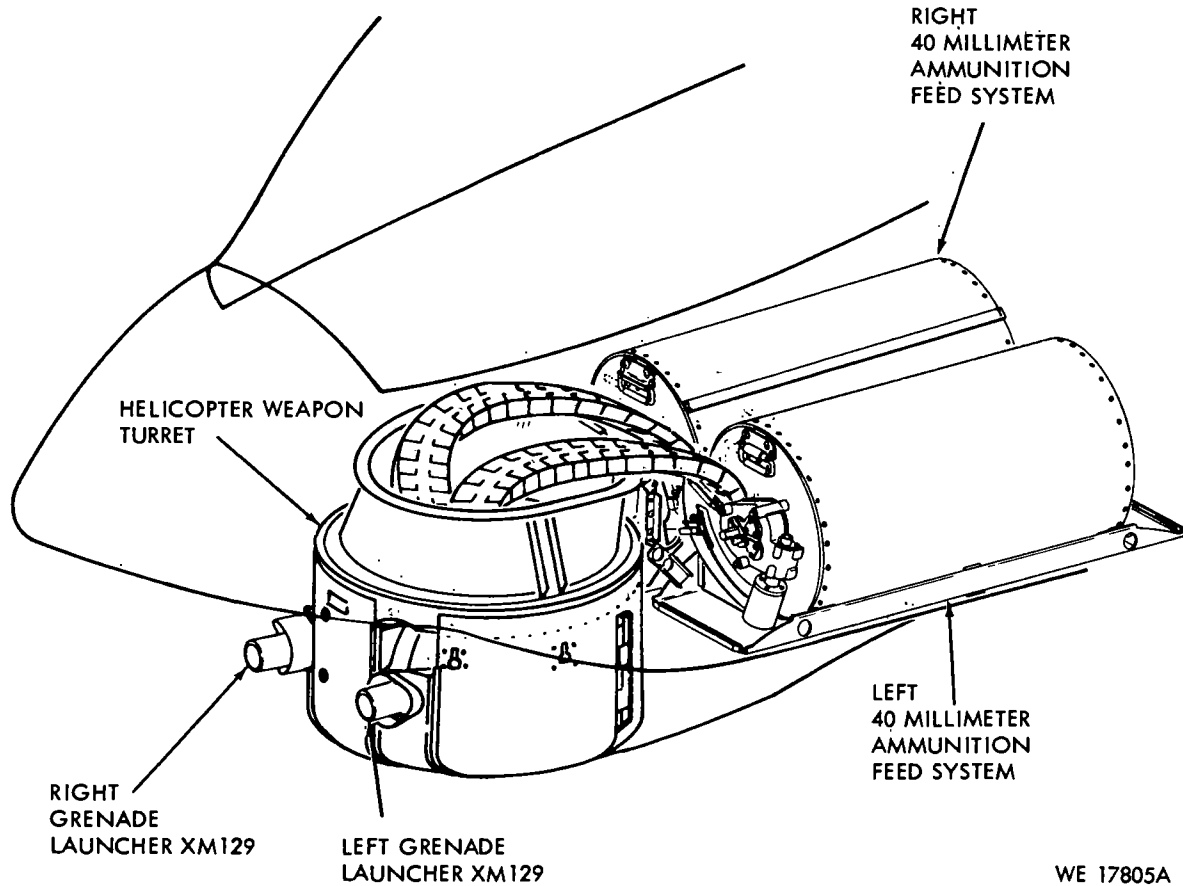


Figure 12-5. Two M129 cartridge launchers.

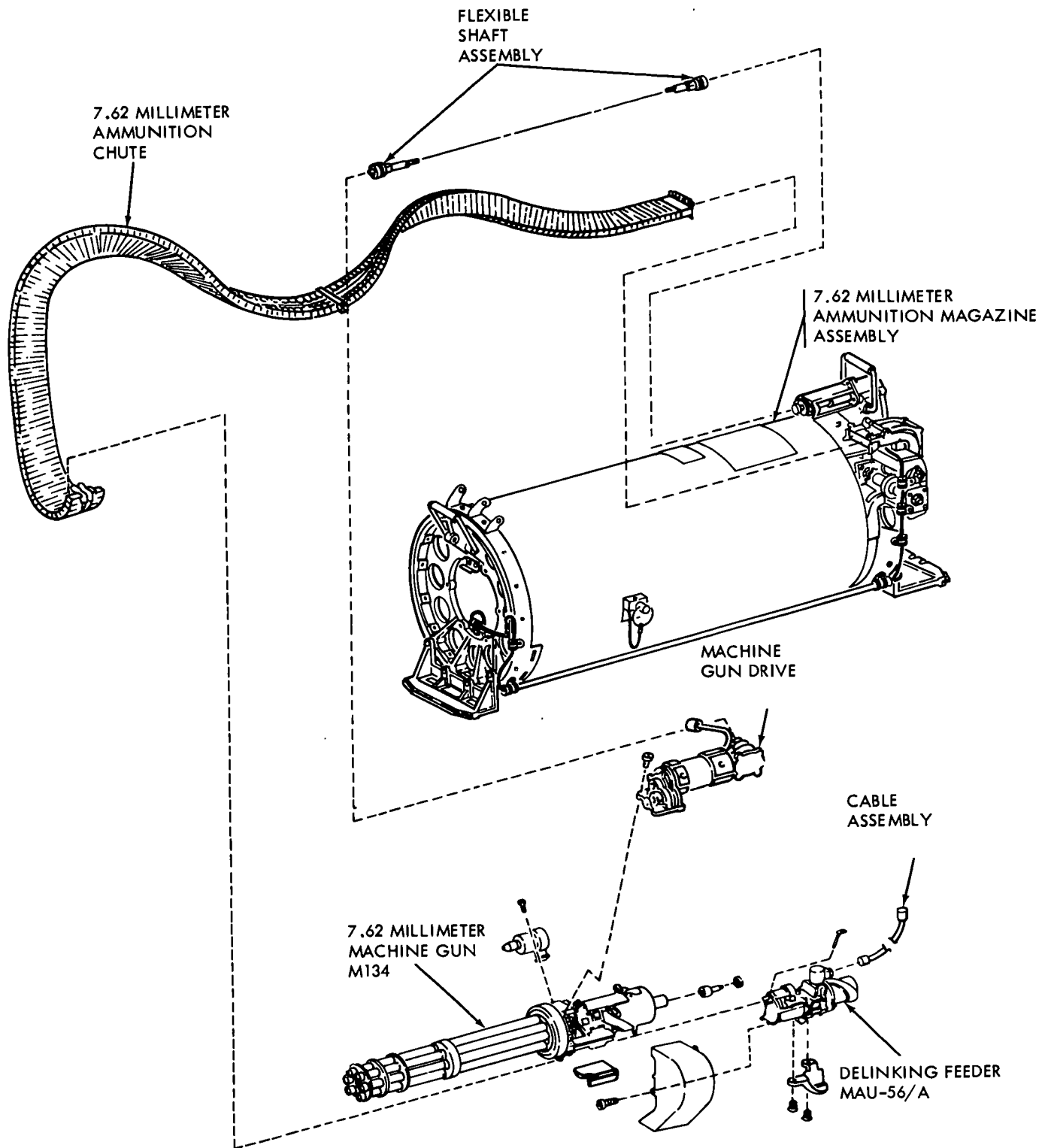
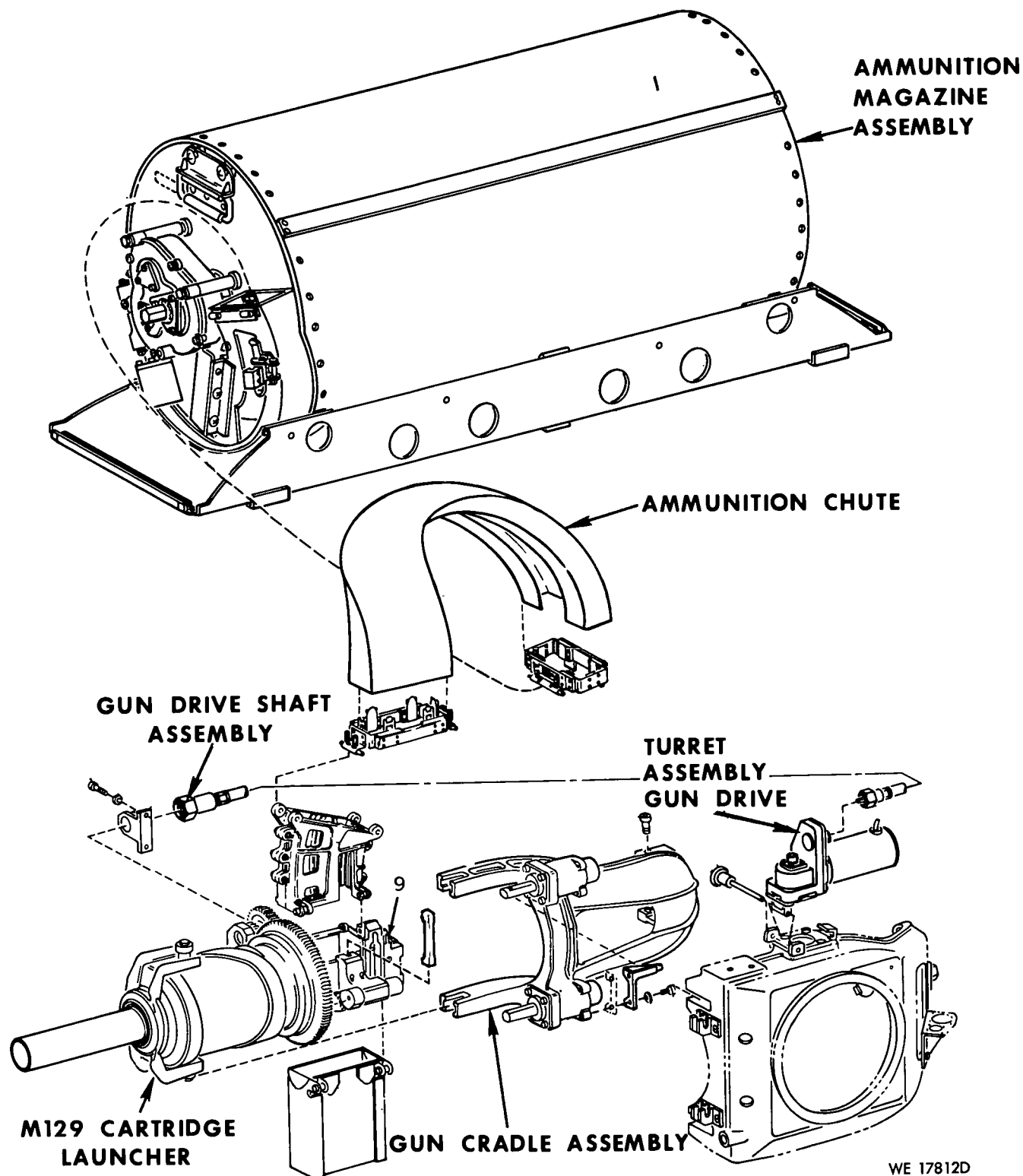


Figure 12-6. M134 machinegun accessory assembly with ammunition magazine assembly.

(a) The crossover assembly, mounted at the rear of the ammunition box assemblies, extracts the linked ammunition from each bay of the ammunition box assemblies in sequence and

feeds the ammunition into the ammunition chute assembly.

(b) The ammunition magazine assembly is located aft of the turret, in the ammunition com-



WE 17812D

Figure 12-7. M129 cartridge launcher accessory assembly.

partment. The assembly is used as improved replacement for the ammunition boxes and cross-over assembly. The cylindrical drum stores 4,000 rounds of linked ammunition in a folded fan arrangement. The capacity may be decreased to 3,000 rounds by inserting the pin located on the side of the drum. The ammunition drum is driven

by the machinegun drive through the flexible shaft assembly.

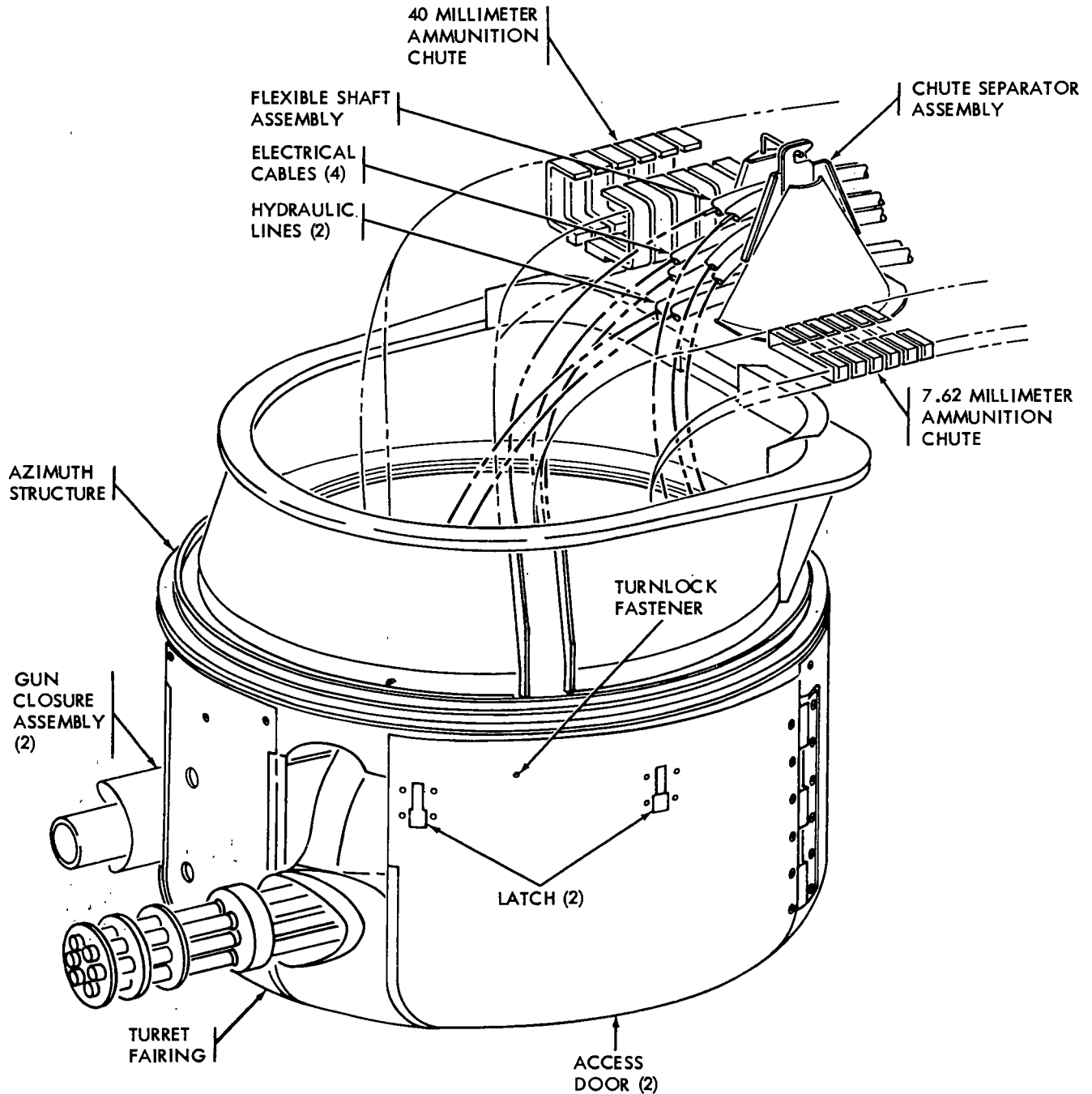
b. *M129 Cartridge Launcher Accessory Assembly.* The M129 cartridge launcher accessory assembly (fig 12-7) consists primarily of the cartridge launcher, gun cradle assembly, turret as-

sembly gun drive, gun drive shaft assembly, ammunition chute, and ammunition magazine assembly.

(1) *Cartridge launcher.* The M129 cartridge launcher is an electrically-driven, rapid firing, air-cooled weapon. It is used to launch antipersonnel fragmentation type projectiles. The single bar-

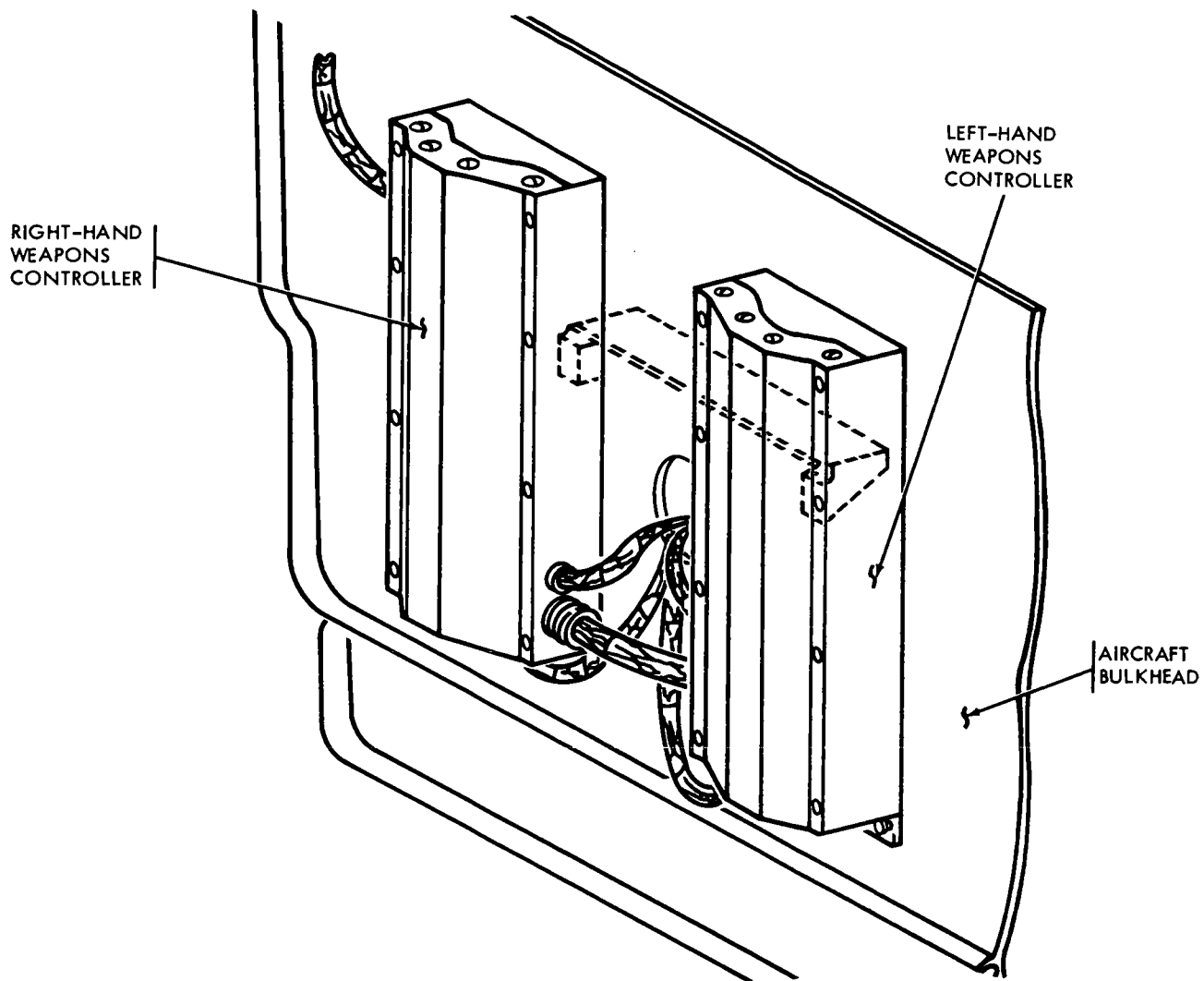
rel cartridge launcher is cam operated, capable of firing 10-second bursts at 400 rounds per minute.

(2) *Gun cradle assembly.* The gun cradle assembly supports the cartridge launcher in the turret. The assembly, which is mounted on the cartridge launcher before installation, is equipped with two recoil adapter assemblies which provide



WE 60671

Figure 12-8. Helicopter weapon turret and chute separator assembly.



WE 60672

Figure 12-9. Weapons gun speed and launcher brake controllers (left- and right-hand).

recoil compensation for the cartridge launcher. The left and right gun cradles are functionally the same, but physically different and are not interchangeable.

(3) *Turret assembly gun drive.* The turret assembly gun drive is mounted on the left or right saddle (turret) when the cartridge launcher is installed. The assembly consists of a direct-current motor and gun drive adapter which operates the cartridge launcher by means of a flexible drive shaft.

(4) *Gun drive shaft assembly.* The gun drive

shaft assembly is a flexible drive shaft connecting the turret assembly gun drive to the launcher drive assembly.

(5) *Ammunition chute.* The ammunition chute is a flexible link channel which guides the ammunition from the ammunition magazine assembly to the feed tray on the cartridge launcher. The left and right ammunition chutes are functionally the same, but physically different, and are not interchangeable.

(6) *Ammunition magazine assembly.* The ammunition magazine assembly, located aft of the

turret in the ammunition compartment, has a capacity of 265 rounds of linked ammunition. The ammunition magazine assembly is electrically driven by a motor mounted on the front of the magazine assembly.

c. Helicopter Weapon Turret and Chute Separator.

(1) *Turret assembly.* The hydraulically-driven turret assembly (fig 12-8) is mounted forward and below the gunner's station inside an aerodynamically designed fairing. The turret can position the weapon 107.5° left or right of the forward position. Weapon elevation is variable from 10.6° to 18.0°, depending on the azimuth position of the turret. The azimuth and elevation travel has electrical and mechanical stop limitations. Weapon depression is 50° in all azimuth positions. The turret assembly traverses in azimuth and elevation in response to electrical signals transmitted from the sighting station to the turret servo valves. The polarity and magnitude of the signals determine the direction and rate of turret and weapons movement. Mechanical stops and electrical limits prevent the turret from being driven beyond its limits. Access to the weapons and internal parts of the turret may be gained by disengaging the two latches and turnlock fastener and opening the access doors on each side of the turret fairing.

(2) The chute separator assembly (fig 12-8) provides separation of the ammunition chute assemblies and support for the hydraulic lines and

electrical cables which pass through the helicopter bulkhead (between ammunition compartment and turret assembly).

d. Weapon Gun Speed and Launcher Brake Controllers (Left- and Right-Hand). The left- and right-hand weapons controllers (fig 12-9) are mounted on the helicopter bulkhead aft of the turret assembly. The left-hand weapons controller contains the required circuitry to control firing speed of the left machinegun or the drive and brake of the left cartridge launcher. The right-hand weapons controller performs the same function for the right machinegun or cartridge launcher.

e. Intervalometers. The intervalometers are located beneath the helicopter's rotor transmission and are accessible through access panels under the right and left wings. The right intervalometer controls the inboard and the left controls the outboard wing stores rocket pod installations. The intervalometer (fig 12-10) is designed to control group or ripple firing of a preselected number of pairs of rockets.

f. Electronic Components Assembly. The electronic components assembly (fig 12-11) is located below the gunner's control panel in the gunner station and is accessible from outside the helicopter. The assembly contains amplifiers, relays, and electronic components used by the control circuit, firing circuit, and master armed bus. Located in the electronic components assembly are six removable plug-in printed circuit card assemblies, azimuth and elevation equalizer amplifiers, azimuth and elevation demodulator detector amplifiers, a dither coincidence amplifier, and a tachometer amplifier.

g. Differential Pressure Transducer. The differential pressure transducer is located above and aft of the left ammunition bay door, and is connected to the helicopter's pitot-static system. Using the pitot-static pressure differential, the transducer feeds airspeed data to the electronic components assembly.

h. Helicopter Turret Sighting Station and Stow Bracket Assembly. The sighting station (fig 12-12) provides the means (line of sight) for the gunner to aim and fire the weapons. The station is located in the gunner station and is mounted on the floor of the helicopter, forward of the gunner. When not in use, it may be stowed by engaging the sight stowlock with the stow bracket assembly adjacent to the gunner's control panel. An off-angle stow bracket jacks the sighting station azimuth gimbal in position so that, when the station

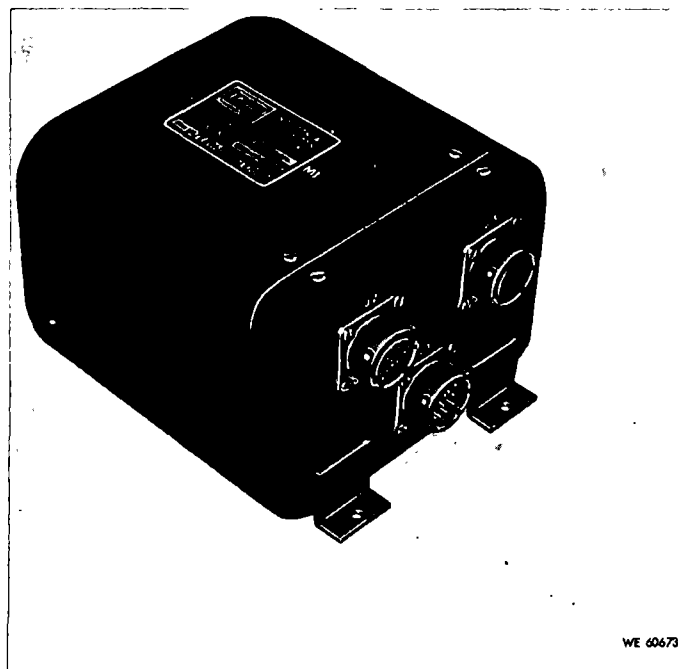
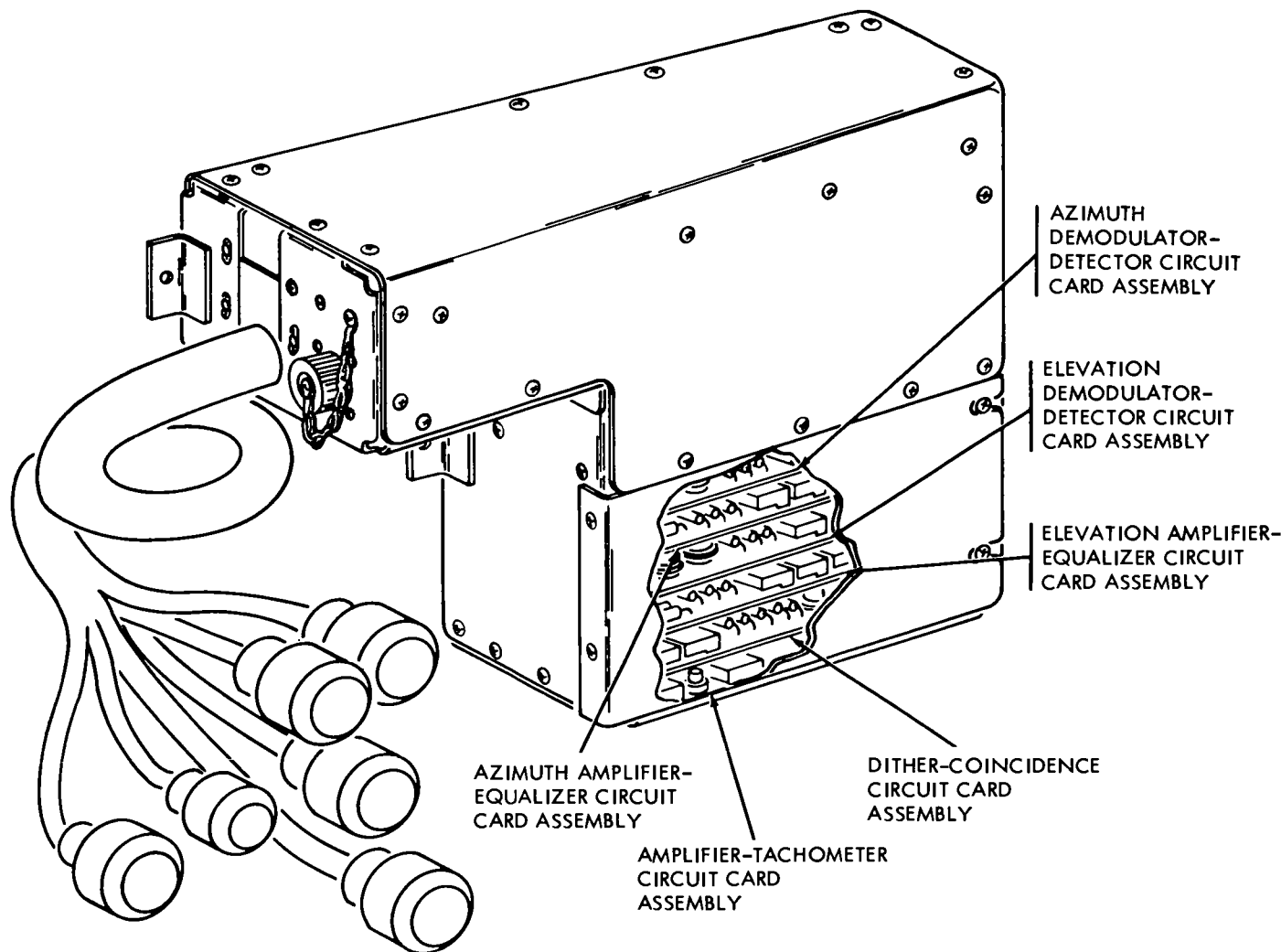


Figure 12-10. Intervalometer.



WE 17856A

Figure 12-11. Electronic components assembly.

is stowed, the sight will not interfere with the canopy. Aiming the weapons is accomplished by superimposing a reticle image (fig 12-13) (projected by the reflex sight) on the target. The projected reticle image has red and white numerals indicating range in hundreds of meters. The red numerals are used when aiming the machinegun; the white numerals are used when aiming the cartridge launcher. The sighting station consists of a reflex sight mounted in a gimbal assembly. Two hand grips, which allow the gunner to position the turret assembly and fire the weapons, are also attached to the gimbal assembly. Movement of the sight generates electrical signals which position the turret assembly.

(1) *Controls.* Sighting station (fig 12-12) controls and their functions are—

(a) The actuator bars are located on the lower forward side of the hand grips. Pressing either or both of the actuator bars applies voltage

to the trigger switches, energizes the gunner action relay, removes the stow signals from the azimuth and elevation stow potentiometers, and applies turret positioning signals to the azimuth and elevation servo valves. Releasing the actuator bars deenergizes the gunner action relay and applies stow signals to the azimuth and elevation servo valves.

(b) The M134 machinegun firing trigger switches are located on the upper forward side of the hand grips. Prior to firing the machinegun, the weapon select switch must be in the position that selects the machinegun for firing and the actuator bar(s) must be pressed. Partially depressing either or both of the trigger switches fires the machinegun at the low rate of approximately 2,000 rounds per minute. Fully depressing either or both trigger switches fires the machinegun at the high rate of approximately 4,000 rounds per minute.

Caution: If a machinegun firing stoppage occurs, immediately release the trigger switches or extensive damage to the equipment may occur. Do not attempt to fire the machinegun until stoppage corrective action has been taken.

(c) The M129 cartridge launcher firing buttons are located on the upper aft side of the hand grips. Before firing the launcher, the weapon select switch must be in the position that selects

the cartridge launcher for firing and the actuator bar(s) must be pressed. Pressing either or both of the firing buttons fires the cartridge launcher at the rate of approximately 400 rounds per minute.

Caution: If a cartridge launcher firing stoppage occurs, immediately release the firing buttons or extensive damage to the equipment may occur. Do not attempt to fire the launcher until stoppage corrective action has been taken.

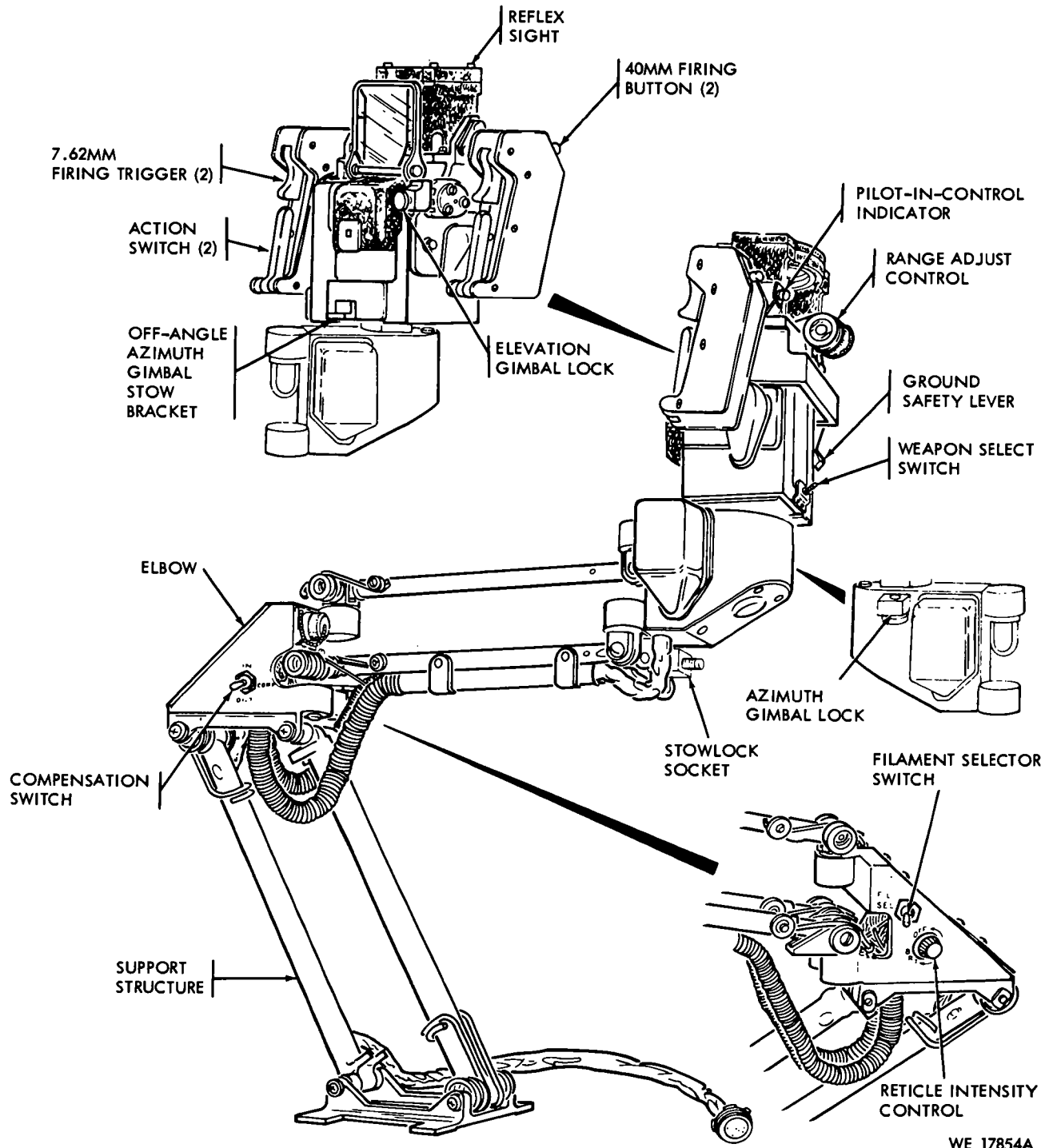


Figure 12-12. Helicopter turret sighting station.

M134 MACHINE GUN

Note
RANGE MARKINGS
ARE IN RED

M129 GRENADE LAUNCHER

Note
RANGE MARKINGS
ARE IN YELLOW

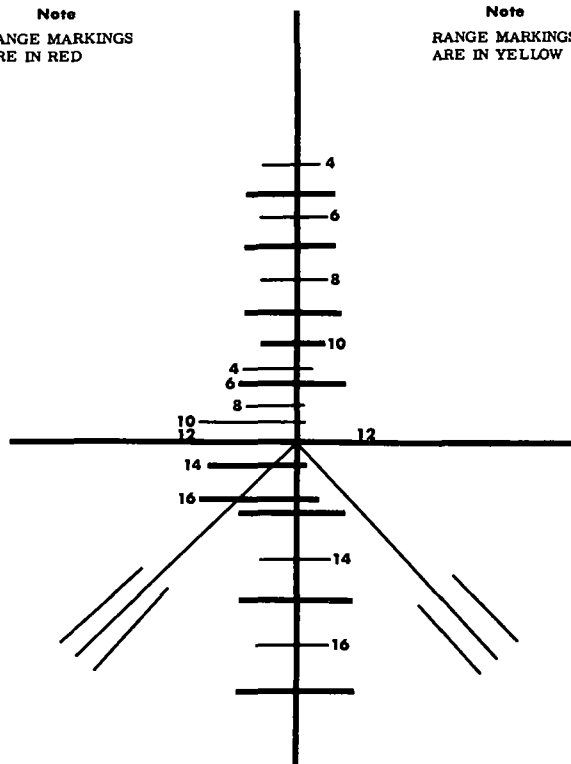


Figure 12-13. Reticle image for helicopter turret sighting.

(d) The compensation (COMP) switch is located on the left side of the support structure elbow. When the switch is placed in the IN position, the compensation relay is energized and airspeed and range data are fed to the turret positioning circuits to provide gun line correction. When the switch is in the OUT position, gun line correction is achieved manually by observing the impact area and positioning the sight to compensate for range and airspeed.

(e) The filament (FIL SEL) selector switch is located on the right side of the support structure elbow. The switch is used to select one of the two filaments of the reticle incandescent lamp.

(f) The reticle intensity control is a variable resistor mounted on the right side of the support structure elbow. This control adjusts the intensity of the sight reticle image.

(g) The range adjust control is a variable resistor mounted above the right-hand grip. The range adjust control knob is calibrated in meters. When the compensation (COMP) switch is in the IN position, the control allows the gunner to supply a range correction input to the turret positioning circuits.

Note. The sighting station has a graduated reticle which may be used for ranging, in lieu of the range adjust control. To range, using the graduated reticle, first posi-

tion the range adjust control to 1,200 meters, then use the reticle graduations to aim the weapons. If the range adjust control is to be used for ranging, index the estimated target range on the range adjust control and aim the weapons, using the reticle center dot.

(h) The ground safety lever, when placed in the up position, prevents the sight head from being depressed more than 35° below horizontal. During ground firing, it prevents the head from being accidentally fully depressed and the rounds from ricocheting into the helicopter.

(i) The azimuth and elevation gimbal locks mechanically lock the sight gimbals at zero degree azimuth and elevation for boresighting and harmonization.

(j) The weapon select switch selects the left or right mounted weapon for firing. When in the BOTH position, both weapons will fire if they are identical weapons. If the turret contains one of each weapon, only the machinegun will fire. The other weapon firing circuit is interrupted to prevent simultaneous firing of unlike weapons.

(2) *Indicator.* The PILOT-IN-CONT indicator (fig 12-12) is located adjacent to the left-hand grip. The indicator illuminates (amber) when the GUNNER/PILOT CONTROL switch on the pilot's control panel is in the PILOT position, indicating that the pilot has control of the subsystem.

(3) *Positioning the turret.* Azimuth and elevation movement of the turret is accomplished by using either or both of the sighting station hand grips. Pressing the actuator bars on the hand grip and positioning the sight horizontally will rotate the turret about its azimuth axis; positioning the sight vertically will move the weapons about their elevation axis. When the hand grips are released, the actuator bars (switches) open and the turret returns to its stowed position.

(4) *Turret coincidence.* If the actuator bar is depressed and the sight rotated at a speed greater than the turret maximum angular velocity, the firing circuit is interrupted and the sight reticle blinks until the gun line is coincident within 5° to the line of sight.

(5) *Firing the M134 machinegun.* Firing the machinegun is accomplished by placing the weapon select switch to the LEFT GUN, RIGHT GUN, or BOTH position (depending upon which position(s) the machinegun is mounted) and using either or both of the hand grips. Pressing the actuator bar and partially depressing the firing trigger switch(es) on front of the grips will fire the machinegun at approximately 2,000 rounds per minute; then, fully depressing the machinegun firing trigger switch(es) will fire the gun at approximately 4,000 rounds per minute.

Note. When firing in the stowed mode with one of each type of weapon mounted in the turret assembly, only the machinegun will fire with the weapon select switch in the BOTH position. The other weapon firing circuit is interrupted to prevent simultaneous firing of unlike weapons. When firing in the FLEX mode, whichever weapon receives the signal first will fire.

(6) *Firing the M129 cartridge launcher.* Firing the launcher is accomplished by placing the weapon select switch to the LEFT GUN, RIGHT GUN, or BOTH position (depending on which position(s) the cartridge launcher is mounted) and using either or both of the hand grips. Pressing the actuator bar and the cartridge launcher firing button(s) on the hand grips will fire the launcher at a rate of approximately 400 rounds per minute. When the trigger button is released, the launcher stops firing.

Warning: At a hover below 125 feet, do not fire the cartridge launcher when the weapon is in the fully depressed position.

Caution: If a launcher firing stoppage occurs, immediately release the firing buttons or extensive damage to the equipment may occur. Do not attempt to fire the launcher until stoppage corrective action has been taken.

i. *Gunner's Control Panel.* The gunner's control panel (fig 12-14) contains the controls and indicators required by the gunner to operate and monitor the M28A1 armament subsystem. Emergency provisions on panel are available for the gunner to take command and fire the system in case the pilot is disabled. The gunner's control panel is located in the gunner station on the right console forward of the flight controls.

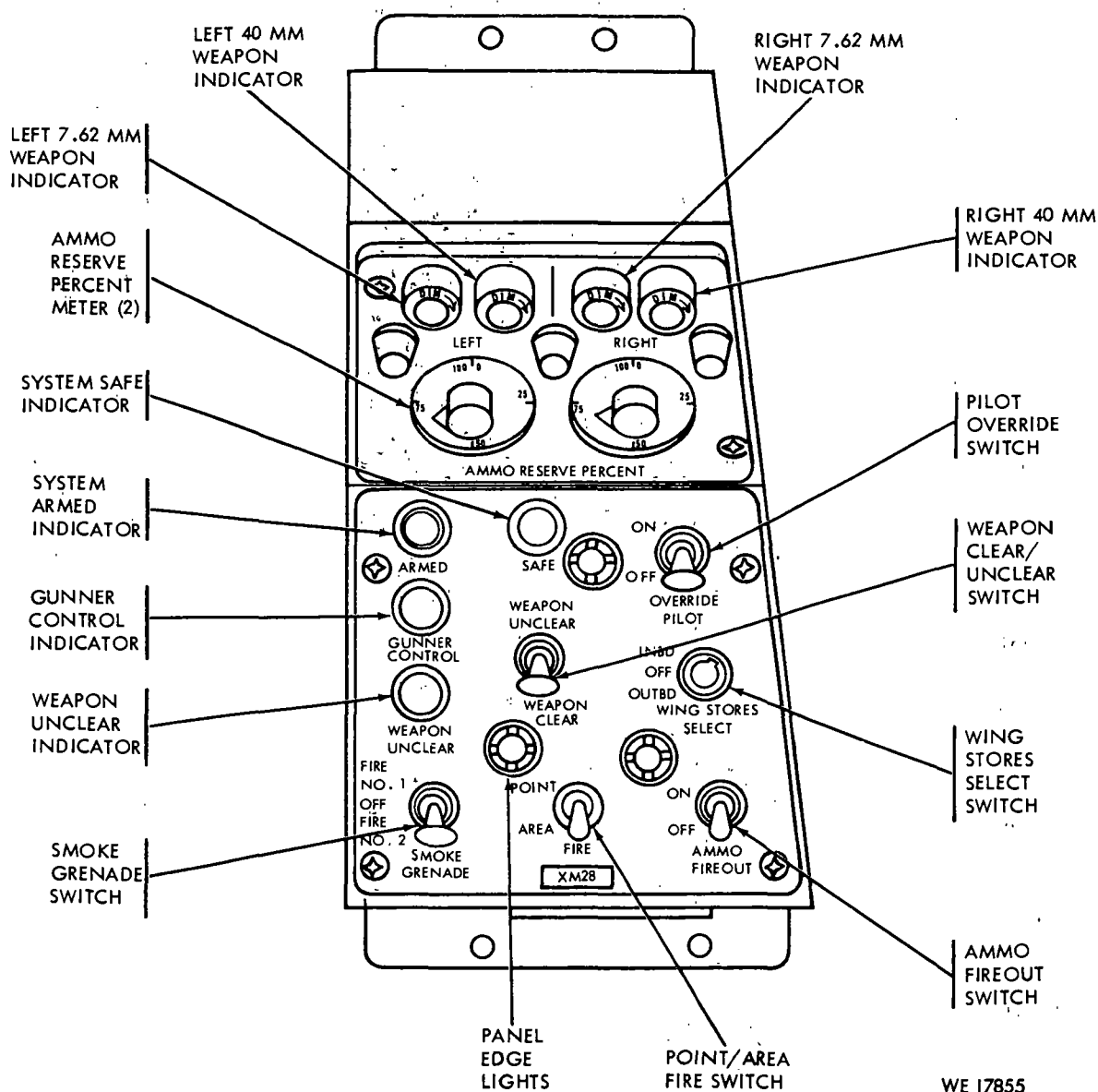


Figure 12-14. Gunner's turret control panel.

(1) *Controls.* Gunner's control panel controls and their functions are—

(a) The OVERRIDE PILOT switch is an emergency switch which permits the gunner to take command of the armament subsystem when the pilot is incapacitated. Placing the switch in the ON position energizes the pilot override relay and transfers control of the armament subsystem and the wing pods to the gunner. In this mode the subsystem is fired in the stowed position, using the trigger switches on the gunner's cyclic control.

Warning: With OVERRIDE PILOT switch in ON position, the system is armed and may be fired. Before landing, place OVERRIDE PILOT switch in OFF position.

(b) The WEAPON CLEAR/UNCLEAR switch (M134 only) selects the mode of firing. When the WEAPON CLEAR/UNCLEAR switch is in the WEAPON CLEAR position at the end of the firing cycle, the machinegun rotates one full revolution after the delinking feeder gate is closed, thus assuring that the machinegun(s) is clear of live ammunition. With the WEAPON CLEAR/UNCLEAR switch in the WEAPON UNCLEAR position, the delinking feeder gate remains open during the last revolution of the machinegun. Since there will be live ammunition chambered in the machinegun, this mode is incorporated only to conserve ammunition and should be used only during combat.

Warning: Use of the UNCLEAR mode of fire for the machinegun presents the hazard of live round cookoff in the weapon from barrel heat. Proper precautions must be taken to protect personnel and property when using this mode.

Caution: Use of the UNCLEAR mode of fire for the machinegun may result in more frequent stoppage.

Note. Placing the WEAPON CLEAR/UNCLEAR switch in the CLEAR position does not affect normal clearing or jam clearing of the M134 machinegun but merely selects the next mode for firing.

(c) The WING STORES SELECT switch functions only when the OVERRIDE PILOT switch is in the ON position. This switch may be used to select either inboard or outboard wing pods for firing. Pod stores are fired by using the triggers on the gunner's cyclic control.

(d) The AMMO FIREOUT (last round) switch in the ammunition box crossover assembly and in the magazine assembly opens when the last round of ammunition passes over the switch, thereby interrupting the electrical signal to the gun drive. The rounds of ammunition remaining in the flexible chutes facilitate the reloading of

ammunition; in an emergency, they may be fired by placing the AMMO FIREOUT switch in the ON position. This permits the electrical signal to bypass the last round switch and allows the remaining rounds of ammunition to be fired.

(e) The POINT/AREA FIRE switch, when placed in the AREA position, energizes the dither circuit and applies a dither voltage to the azimuth servo valve causing the weapons to oscillate 60 mils in azimuth about their trained position. Placing the switch in the POINT position removes the dither voltage from the azimuth servo valve and allows the gun to remain stable in its trained position.

(f) The SMOKE GRENADE switch is a lever-lock momentary switch that permits the selection and firing of system number 1 and number 2 smoke grenades. When placed in the FIRE NO. 1 position, the colored smoke grenades in system number 1 drop. When placed in the FIRE NO. 2 position, the colored smoke grenades in system number 2 drop. When placed in the OFF position, the smoke grenade circuits are deactivated.

(2) *Indicators.* Gunner's control panel (fig 12-14) indicators and their functions are—

Note. The incandescent lamps in the indicators on the gunner's control panel may be tested by pressing the indicator lens. The lamp intensity may be varied by rotating the indicator lens.

(a) The system ARMED indicator illuminates (amber) when the pilot's MASTER ARM switch is placed in the ARMED position or when the gunner's OVERRIDE PILOT switch is placed in the ON position, indicating that the turret control system is energized.

(b) The GUNNER CONTROL indicator illuminates (blue) when the pilot places the GUNNER/PILOT CONTROL switch on the pilot's control panel in the GUNNER position or when the gunner places the OVERRIDE PILOT switch in the ON position, indicating the gunner has control of the subsystem.

(c) The SAFE indicator illuminates (green), indicating the subsystem (except the firing circuits) is energized, when the pilot places the GUNNER/PILOT CONTROL switch in the GUNNER or PILOT position and the MASTER ARM switch in the SAFE position.

(d) The WEAPON UNCLEAR indicator is based on the mode of the previous firing while the WEAPON UNCLEAR/CLEAR switch selects the mode of the next firing. When the last firing was in the UNCLEAR mode, the WEAPON UNCLEAR indicator will illuminate and remain illuminated until the weapon is fired in the CLEAR mode.

(e) When the left weapon indicator light is illuminated, it indicates the type of weapon mounted in the left side of the turret assembly.

(f) When the right weapon indicator is illuminated, it indicates the type of weapon mounted in the right side of the turret assembly.

(g) The AMMO RESERVE PERCENT meters indicate the percentage of 4,000 rounds of ammunition remaining in the M134 machinegun ammunition box assemblies or magazine assembly, or the percentage of 270 (± 5) rounds of ammunition remaining in the M129 cartridge launcher magazine assembly.

Note. The ammo reserve percent meters depend on correct loading procedures for accuracy in indicating the percent of rounds remaining in each system.

(h) The panel edge lights provide panel lighting and are controlled from the gunner's miscellaneous control panel.

j. Pilot's Control Panel. The pilot's turret control panel (fig 12-15) contains the controls and indicators required by the pilot to arm and fire the M28A1 armament subsystem with the weapons in stowed position. Pilot's control panel (fig 12-15) controls and their functions are—

(1) The MASTER ARM switch is a three-position switch which permits the pilot to energize and deenergize the armament circuits. When placed in the ARMED position, the switch arms the basic weapon system; in the SAFE position, it energizes only the control circuits; and in the

OFF position, it deenergizes the armament and control circuits.

(2) The GUNNER/PILOT CONTROL switch is a two-position switch which designates control of the firing circuits. When placed in the GUNNER position, it permits gunner control of the subsystem firing circuits. When placed in the PILOT position, it permits pilot control of the subsystem firing circuits.

(3) The POINT/AREA FIRE switch is a two-position switch which allows the guns to oscillate or remain in a stable position. When placed in the POINT position, the guns remain stable in the trained position. When placed in the AREA position, the guns will oscillate 60 mils in azimuth about their trained positions.

(4) The WEAPON SELECT switch is a three-position switch which allows selection of the left and right weapons for firing simultaneously or individually. When placed in the L (left) position, the left weapon is selected for firing. When placed in the R (right) position, the right weapon is selected for firing. When placed in the BOTH position, both weapons will fire simultaneously if they are identical (two machineguns or two cartridge launchers). If one of each weapon is installed in the turret assembly, only the machinegun will fire when the switch is placed in the BOTH position.

k. Reflex Sight M73. The reflex sight (fig 12-16) is located above the pilot's instrument

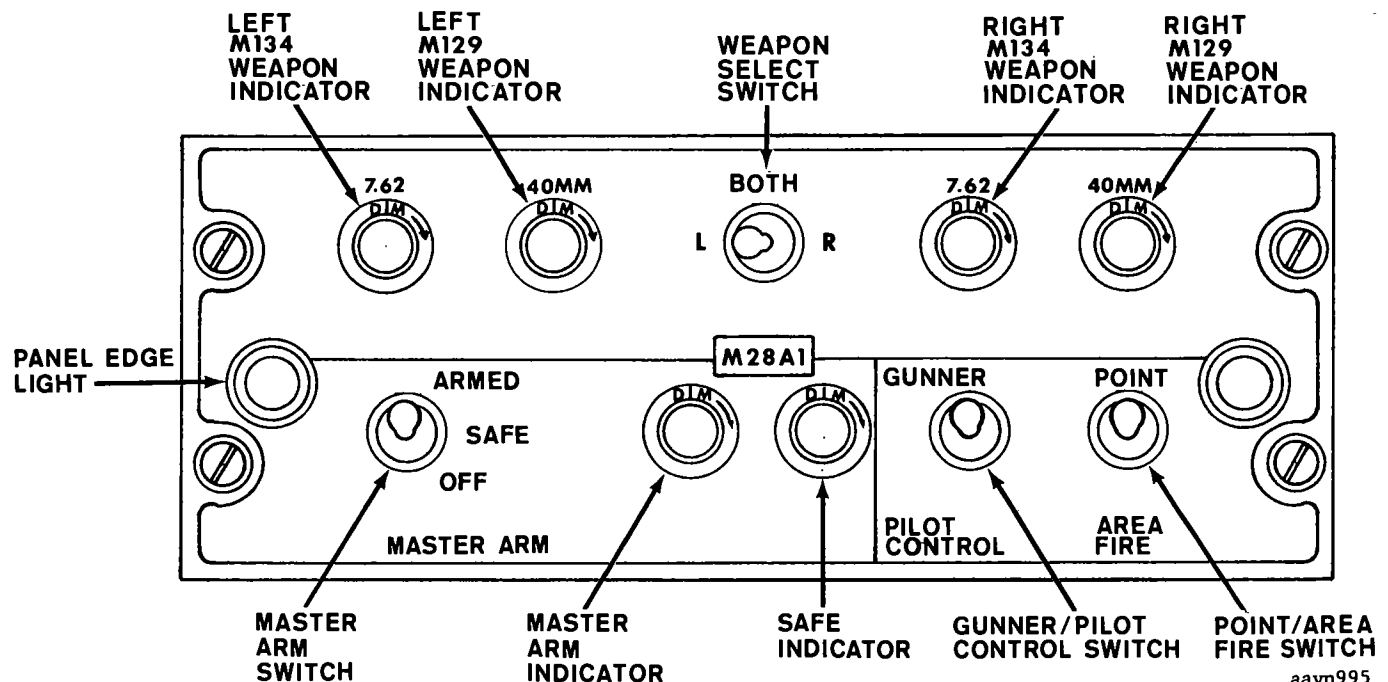
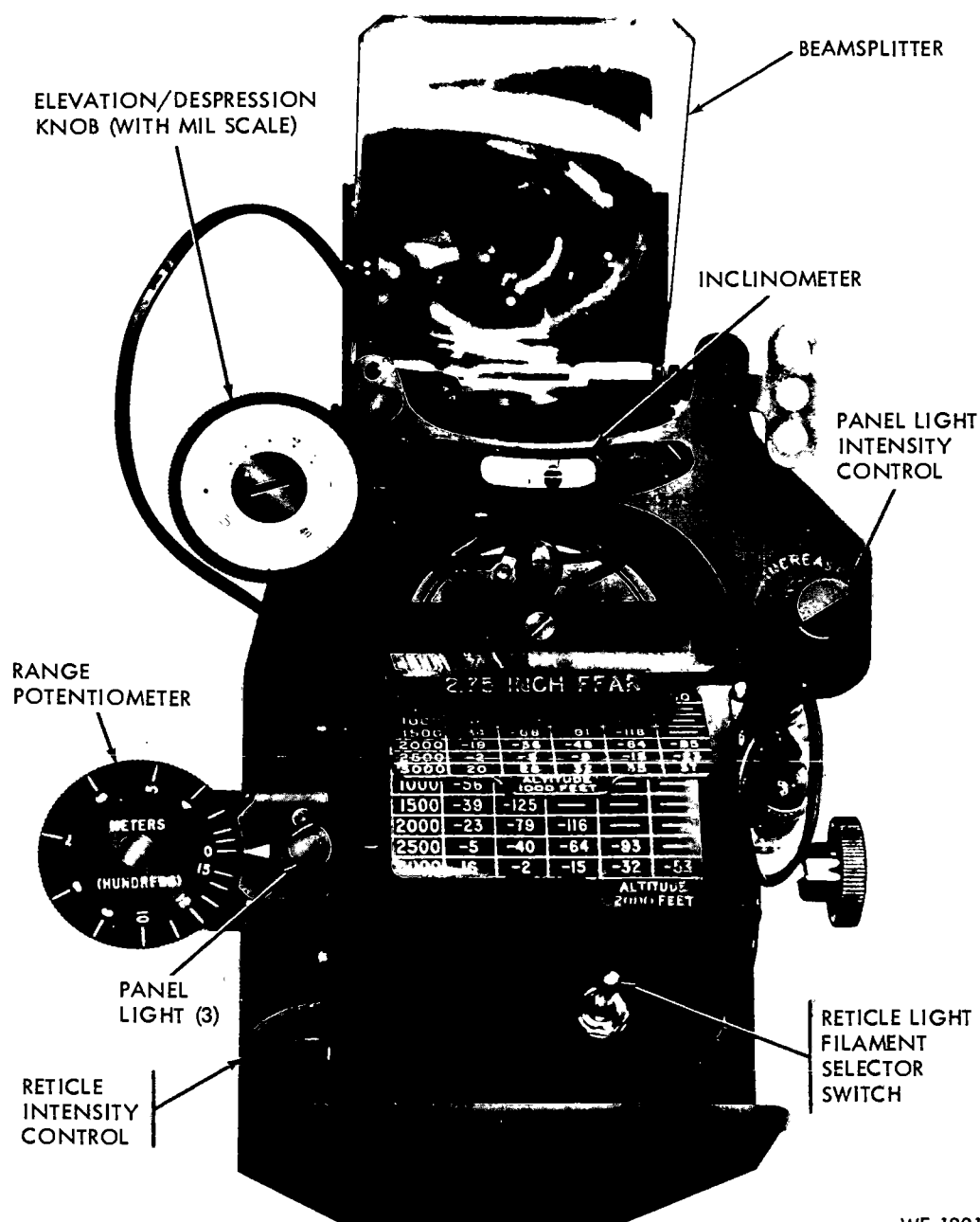


Figure 12-15. Pilot's M28A1 turret control panel.



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Figure 12-16. M73 reflex sight.

panel. It provides a projected reticle image (fig 12-17) for the pilot's use when firing the wing stores or turret weaponry from a target collision course. For the wing stores, the pilot uses the elevation/depression knob to set in correction per the ballistic data cards. For turret weaponry, the range potentiometer is used for superelevation. The reflex sight contains the following controls and items.

(1) *Elevation/depression knob.* This knob allows the pilot to vary the angle of the beamsplit-

ter to adjust for range and airspeed when firing the wing stores.

(2) *Reticle intensity control.* This control allows the pilot to adjust the illumination intensity of the sight reticle image (fig 12-17).

(3) *Inclinometer.* The inclinometer indicates aircraft yaw attitude (trim) to the pilot and is used when firing the wing stores and turret.

(4) *Range potentiometer control.* This control allows the pilot to apply an elevation correctional signal to the turret weapons.

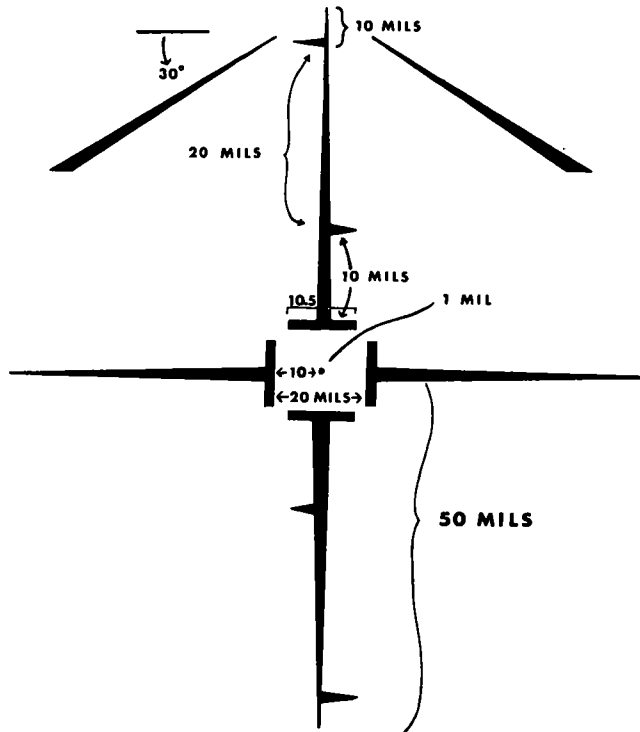


Figure 12-17. Recticle image for M73 reflex sight.

(5) *Reticle light filament selector switch.* This selector switch allows the pilot to select one of two filaments of the sight reticle lamp.

(6) *Panel lights.* The panel lights are used to light the panel on the sight during operation.

(7) *Panel light intensity control.* This control allows the pilot to adjust the illumination intensity of the panel lights.

(8) *Reflex sight support assembly.* This support assembly is secured to the top of the pilot's instrument panel and provides hard point mounting for the reflex sight reticle intensity control (rheostat) and filament selector switch.

(9) *Indicators.* Pilot's M28A1 turret control panel (fig 12-15) indicators and their functions are—

Note. The incandescent lamps in the indicators on the pilot's control panel may be tested by pressing the indicator lens. The lamp intensity may be varied by rotating the indicator lens.

(a) When the left weapon indicators are illuminated, the type of weapon mounted in the left side of the turret assembly is indicated.

(b) When the right weapon indicators are illuminated, the type of weapon mounted in the right side of the turret assembly is indicated.

(c) When the SAFE indicator is illuminated (green), MASTER ARM switch is indicated in the SAFE position.

(d) When the ARMED indicator is illuminated (amber), MASTER ARM switch is indicated in the ARMED position.

(e) The panel edge lights provide panel lighting and are controlled from the pilot's light control panel.

1. Pilot's Wing Stores Control Panel. The pilot's wing stores control panel (fig 12-18) is located in the pilot's center console. It contains the necessary controls to provide the pilot with primary control over the selection and arming of wing stores armament and material jettison. Pilot's wing stores control panel (fig 12-18) controls and indicators and their functions are—

(1) The WG ST JETTISON SELECT switch permits the pilot to jettison outboard wing stores (OUTBD position) or inboard stores (INBD position).

(2) A five-position rotary RKT PR SEL switch is for selecting rocket pairs. Position 1 selects one pair of rockets for firing. Positions 2, 4, 7, and 19 select a quantity of rocket pairs for firing, according to the preselected position of the switch.

(3) The WG ST ARM switch permits the pilot to select either inboard (INBD) or outboard (OUTBD) wing stores for firing.

12-3. Operation of Smoke Grenade Dispenser XM118

For details on the operation of smoke grenade dispenser XM118, see TM 9-1330-208-25 and 55-1520-221-10.

12-4. Boresighting and Troubleshooting

For boresighting and troubleshooting procedures, see TM 9-1090-203-12.

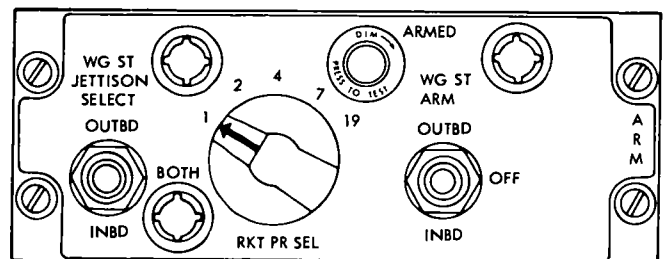


Figure 12-18. Pilot's wing stores control panel.

Section II. M35 ARMAMENT SUBSYSTEM

12-5. Description and Operation

The M35 armament subsystem (fig 12-19) provides 20-millimeter firepower at the rate of 750 shots per minute. The sighting equipment and some circuitry of the M28A1 armament subsystem are used in conjunction with this subsystem.

The M28A1 MASTER ARM and WG ST ARM switches must be activated. Normally, the pilot fires the gun; however, the gunner or copilot can fire the weapon by using the PILOT OVERRIDE switch on the M28A1 gunner's control panel. For subsystem characteristics, see tables 12-1 and 12-2. Components of the subsystem are—

Table 12-1. M35 Armament Subsystem Characteristics

Weight	1,186.5 lbs (loaded), 550 lbs (empty).
Ammunition capacity	Approximately 950 rounds.
Gun	M195.
Ammunition	M51A1B1, M52E1, M53, M54A1, M55A2, M56A3.
Gun drive	Electrical.
Basic life	100,000 rounds.
Links	M14A1.
Accuracy	6 mils radial, standard deviation.
Turn-around and reload time	15 minutes.
Reliability	15,000 mean rounds between failures.
Crash load requirement	6 G maximum.
Ammunition feed	Linked.
Type of ammunition storage	Box.
Boresight adjustment	± 1½ degrees in azimuth and elevation.

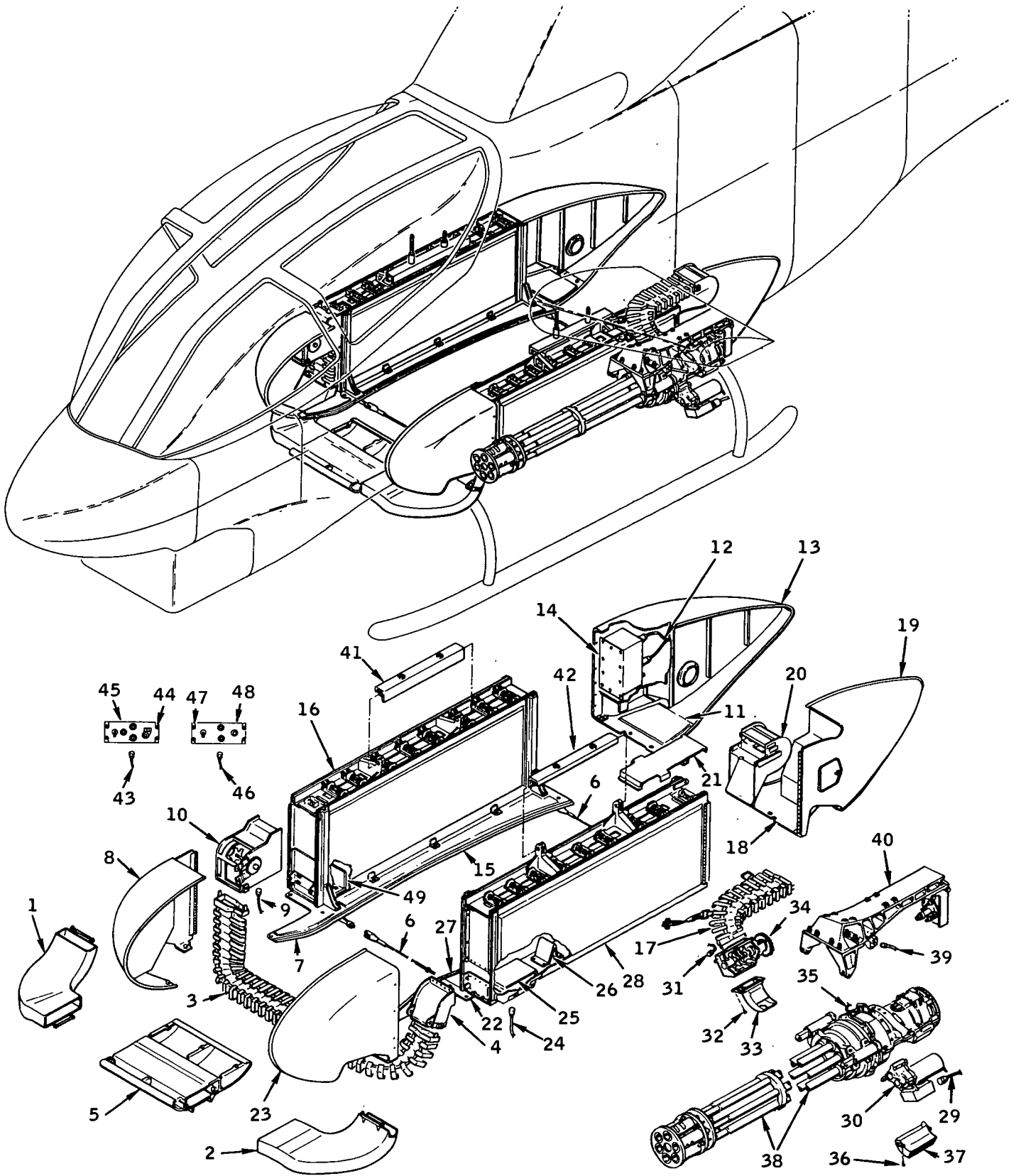
Table 12-2. M195 Gun Characteristics

Caliber	20mm.
Overall length	Approximately 60 inches.
Reliability	25,000 mean rounds between failures.
Number of barrels	6.
Length	40 inches.
Lands	9.
Twist	Gain.
Rotation of barrel cluster	Counterclockwise, viewed from rear of gun.
Firing rate:	
Maximum	850 shots per minute.
Minimum	650 shots per minute.
Burst limits	Unlimited (100-200 rounds—7 to 14 seconds recommended for maximum barrel life).

Key to figure 12-19.

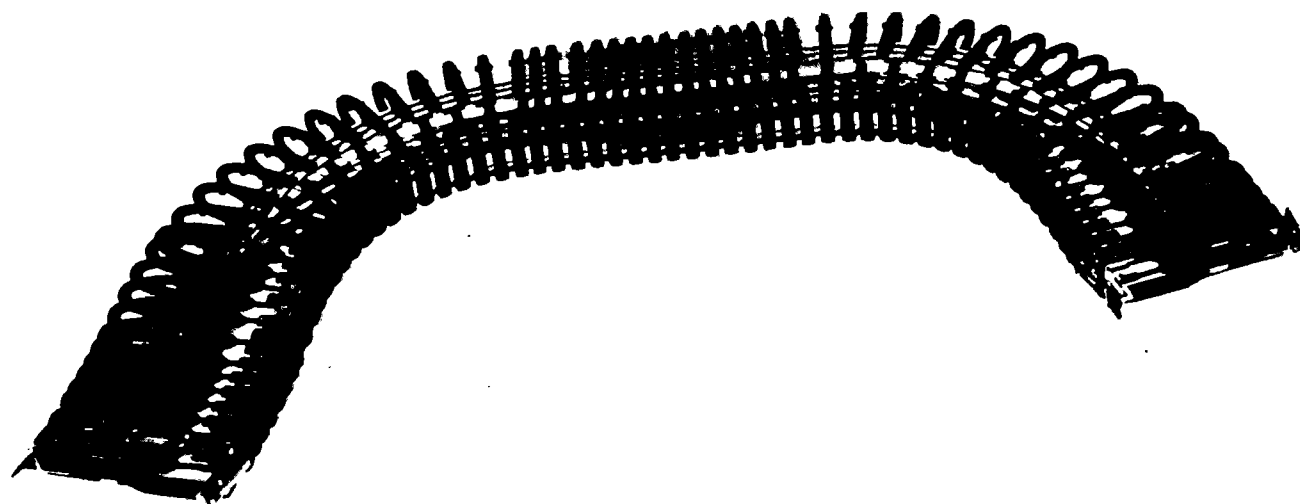
1. RH chute support.
2. LH chute support.
3. Crossover gun feed chute assembly.
4. Chute adapter assembly.
5. Cross chute fairing assembly.
6. Wire rope assembly.
7. RH lower forward panel assembly.
8. RH forward fairing assembly.
9. Electrical cable connector P279.
10. Ammunition booster assembly.
11. RH lower aft fairing panel.
12. Electrical cable connector P280.
13. RH aft fairing assembly.
14. Gun firing control unit.
15. RH ammunition box to fuselage panel assembly.
16. RH ammunition box assembly.
17. Gun feed chute assembly.
18. LH lower aft panel assembly.
19. LH aft fairing assembly.
20. Bellmouth assembly.
21. Flexible chuting shield assembly.
22. LH lower forward panel assembly.
23. LH forward fairing assembly.
24. Electrical cable connector P271.

25. Booster switch assembly.
26. LH rounds retainer.
27. LH ammunition box to fuselage panel assembly.
28. LH ammunition box assembly.
29. Electrical cable connector P274.
30. Gun drive assembly.
31. Electrical cable connector P272.
32. Screw.
33. Delinking chute assembly.
34. Delinking feeder assembly XM87.
35. Electrical cable connector P273.
36. Screw.
37. Ejection chute assembly.
38. 20 Millimeter automatic gun XM195.
39. Electrical cable connector J295.
40. Gun mount assembly.
41. Wing attach adapter assembly.
42. Wing attach adapter assembly.
43. Electrical cable connector P282.
44. Screw.
45. Pilot armament control panel.
46. Electrical cable connector P286.
47. Screw.
48. Gunner armament control panel.
49. RH rounds retainer.

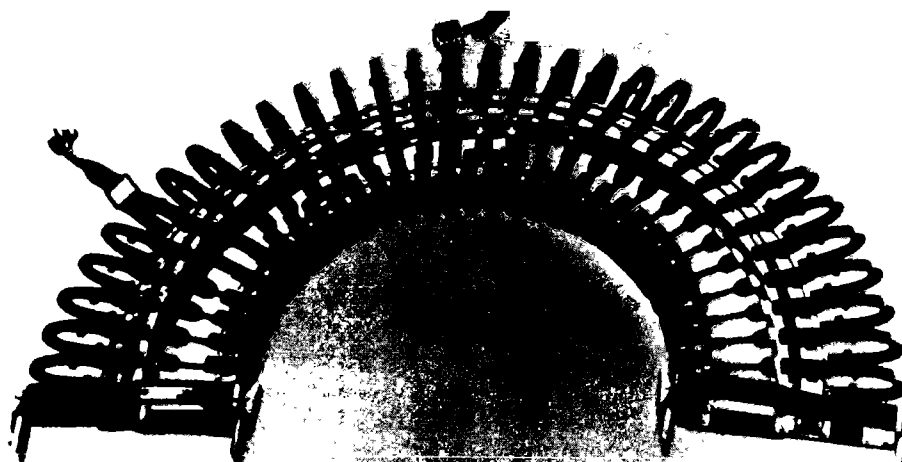


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Figure 12-19. M35 armament subsystem.



A. CROSSOVER GUN FEED CHUTE



B. FEEDER GUN FEED CHUTE

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Figure 12-20. M35 gun feed chute assemblies.

a. Crossover Gun Feed Chute. The crossover gun feed chute (A, fig 12-20) permits the transfer of linked ammunition from the RH to the LH ammunition box after ammunition in the LH box is exhausted. A cross chute fairing protects the chute and provides reduced drag for the aircraft.

b. Booster Assembly. The booster assembly (fig 12-21) is located on the forward end of the gun feed RH ammunition box. It assists the feeder by pushing ammunition from the right box through the crossover gun feed chute into the LH ammunition box when that box is empty. The booster is actuated by the booster switch, located in the bottom of the LH ammunition box.

c. M35 Gun Firing Control Unit. The gun firing

control unit (fig 12-22) is located on the aft end of the RH ammunition box. When the ARM/OFF switch on the pilot's control panel is placed in the ARM position, the gun firing control unit is energized. When the trigger switch on the cyclic stick is pressed, the gun firing control unit controls the application of power to the gun firing contact assembly, gun drive assembly, declutching/delinking feeder, and rounds counter. The gun drive motor series field and booster motor is powered from the helicopter 24-volt dc battery, while all other circuits operate off the helicopter's 28-volt dc bus.

d. RH Ammunition Box Assembly. The RH ammunition box is attached beneath the right sponson (stub wing) by the adapter assembly. The box

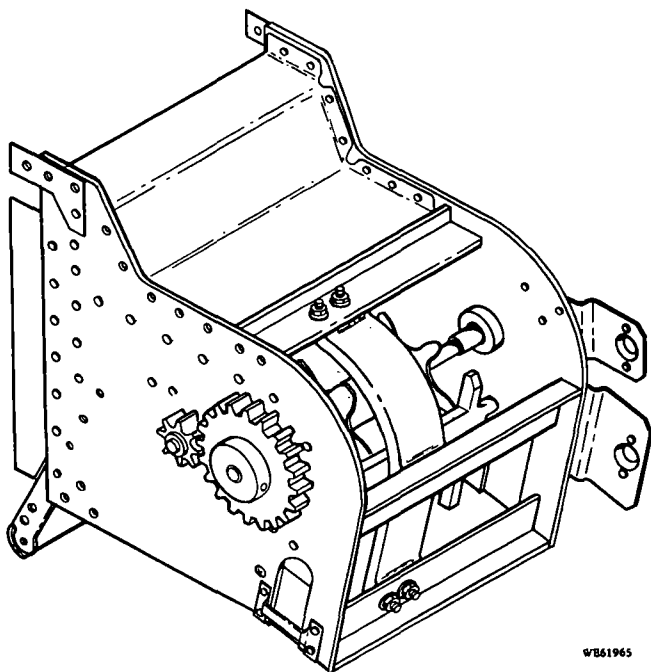


Figure 12-21. Booster assembly.

is held in position against the aircraft skin by two wire rope assemblies connected between the RH and LH ammunition boxes. The RH ammunition box stores approximately 400 rounds of linked ammunition. Attached to the front and rear ends of the box are aerodynamic fairing sections designed to reduce drag. The front fairing section houses the booster assembly and is hinged for easy access. The rear fairing section houses the gun control unit.

e. LH Ammunition Box Assembly. The LH ammunition box is attached beneath the left sponson

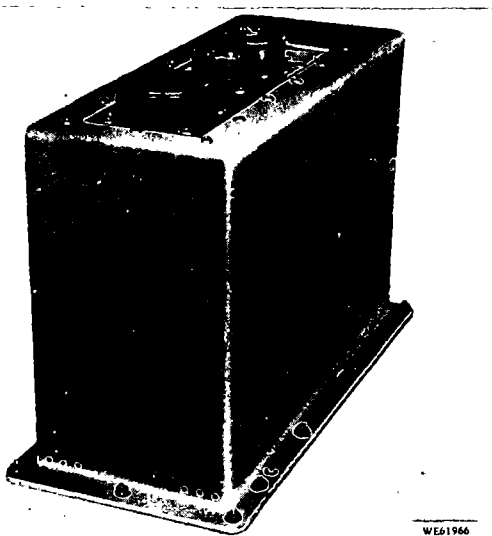


Figure 12-22. Gun firing control unit.

(stub wing) by the adapter assembly. The LH box is held in position against the aircraft skin by two wire rope assemblies connected between the RH and LH ammunition boxes. The LH box stores approximately 415 rounds of linked ammunition. Attached to the front and rear ends of the box are aerodynamic fairing sections designed to reduce drag. The aft fairing section houses the bellmouth assembly and is hinged for easy access. The shield is attached to the top rear section of the box, and the booster switch is located on the access door in the bottom front portion.

f. Feeder Gun Feed Chute. The feeder gun feed chute (B, fig 12-20) guides linked ammunition from the bellmouth assembly to the declutching/delinking feeder.

g. Bellmouth Assembly. The bellmouth assembly is mounted on the aft end of the LH ammunition box. This assembly has a single turn-around roller (hub). The hub, located within the bellmouth, changes the direction of ammunition flow 180° as it emerges from the box.

h. Shield. The shield is located on the top aft portion of the LH ammunition box and is held in place by the top mounting pin of the bellmouth assembly. The shield supports the flexible feed chute so that ammunition flow will not be restricted during firing.

i. Booster Switch. The booster switch is mounted on the inside of the access door, located on the forward bottom of the LH ammunition box. The booster switch is held in the OFF position by the weight of stored ammunition. When the ammunition supply in the box is exhausted, the booster switch actuates, energizing the booster

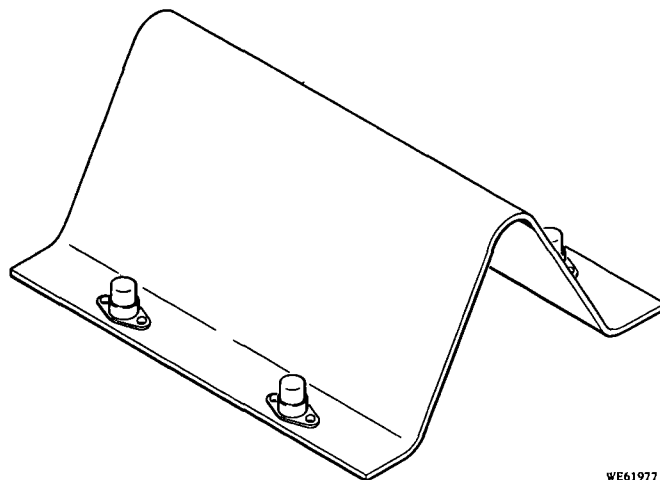


Figure 12-23. Rounds retainer.

motor and causing ammunition to be transferred from the RH ammunition box to the LH ammunition box.

j. Rounds Retainer. The rounds retainer (26, fig 12-19 and 12-23) is located to the rear of the booster switch in the bottom of the LH ammunition box. When ammunition is being transferred from the RH ammunition box, and the firing cycle terminates, the rounds retainer causes ammunition to pile up and turn off the booster switch.

k. Electrical Cable Assemblies. The right and left electrical cable assemblies provide the electrical connections between the helicopter wiring and armament subsystem M35. A quick-disconnect firing lead cable is connected between the firing contact assembly on the gun and the ring mount.

l. Gun Drive Assembly. The gun drive assembly (fig 12-24) is mounted on the housing of the M195 gun and is powered by a 24-volt direct current that drives the gun motor assembly. The gun drive assembly drives the rotor assembly during a firing cycle and brakes the gun at the end of the firing burst. An integral gear train friction clutch limits torque output. This protects subsystem components from damage in case of a stoppage. A manual brake release lever (fig 12-24), located on the aft end of the drive motor, enables manual rotation of the barrel cluster.

Warning: When preflighting the M35 20mm automatic gun, if ammunition is present in the system the gun may fire if rotated by hand. The pilot/gunner should not attempt to perform operational checks with ammunition present in the system. If operation of the weapon is in doubt, qualified armament personnel should be contacted for safe clearing procedures.

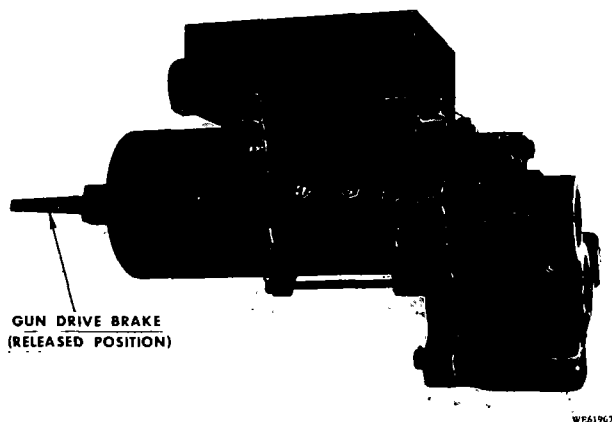


Figure 12-24. Gun drive assembly.

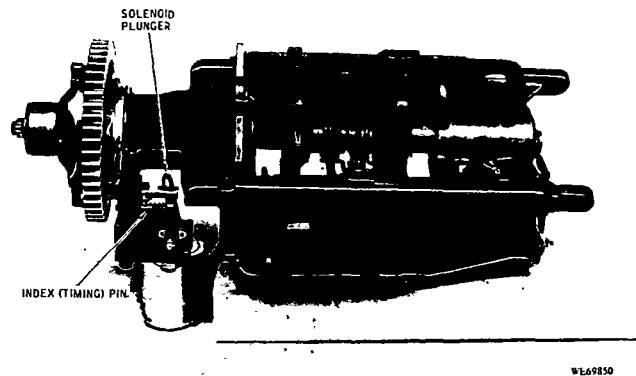


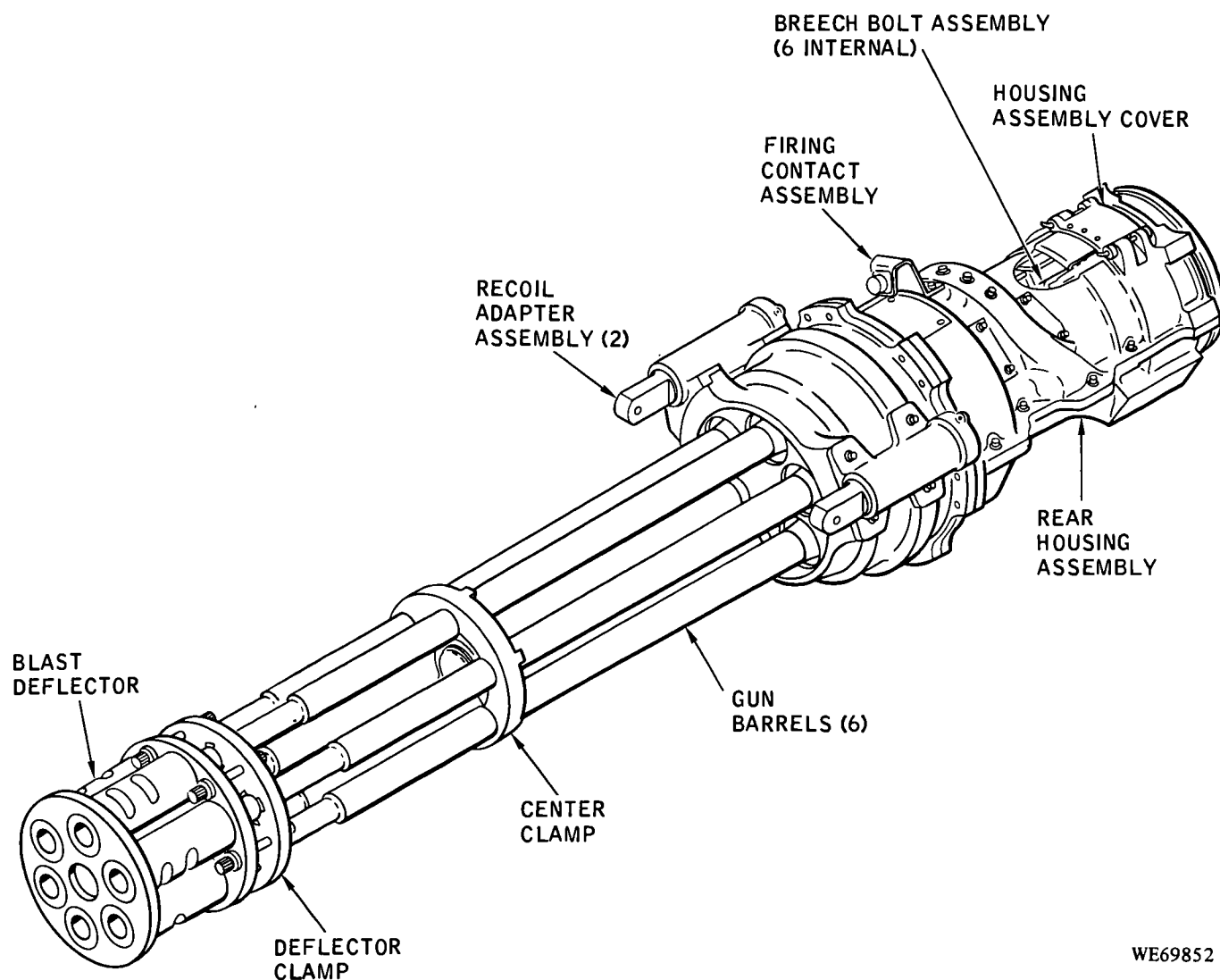
Figure 12-25. Automatic gun feeder assembly XM87.

m. Automatic Gun Feeder Assembly XM87. The feeder gun feed chute is attached to the automatic gun feeder assembly (fig 12-25) mounted on the M195 gun. As linked ammunition passes through the feeder, each round is stripped from its link and fed into the gun. The links follow a T rail and are ejected through the declutching/delinking chute assembly. Upon trigger release, the feeder declutches and stops feeding rounds into the gun. A time delay allows the gun to continue firing rounds already fed.

n. Delinking Chute Assembly. The delinking chute assembly is attached to the declutching/delinking feeder and separates the links as they drop through the chute. This prevents the possibility of a long loop of links hanging beneath the helicopter or damaging the tail rotor.

o. 20mm Automatic Gun M195. The M195 gun (fig 12-26) is an electrically-driven, air-cooled weapon using electrically-fired ammunition. The Gatling type gun has six barrels arranged in a cluster and retained in a rotor assembly which revolves on bearings within a stationary housing. The major subassemblies of the gun are the housing assembly, the rotor assembly, and the gun drive assembly. The firing cycle begins when power is applied simultaneously to the firing contact assembly and the gun drive assembly. The gun drive assembly turns the rotor assembly, and interaction between the bolt assemblies and the main cam path on the inside of the housing assembly causes the gun to feed, chamber, lock, fire, extract, and eject ammunition. Rotation of the barrel cluster is in a counterclockwise direction, as viewed from the rear. The position of the firing barrel is at approximately 12 o'clock, while the feed/eject position is at approximately 6 o'clock.

p. Wing Mount. The wing mount is located under the left sponson (stub wing) and is secured by eight bolts. The wing mount supports the gun



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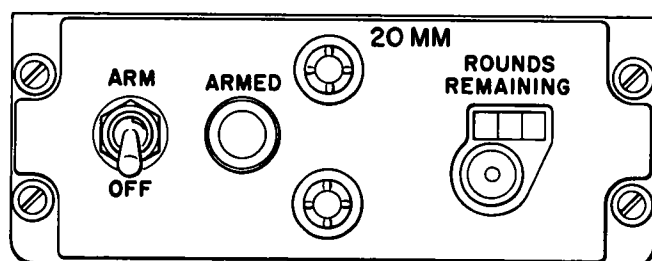
Figure 12-26. 20mm automatic gun M195.

and makes provision for boresight adjustment up to 1.5° in azimuth and elevation.

q. Pilot's Armament Control Panel. The pilot's control panel (fig 12-27), located in the pilot's cockpit, permits the pilot to fire the M195 gun. The subsystem is controlled by the ARM/OFF

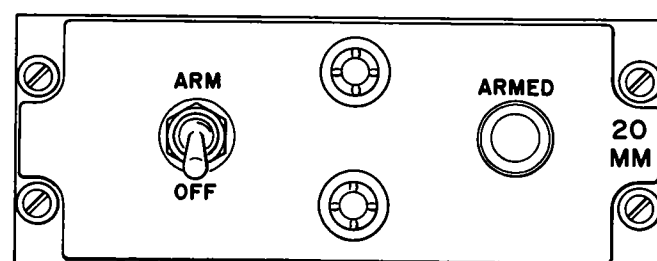
and trigger switches located on the control panel and cyclic stick, respectively.

r. Gunner's Armament Control Panel. The gunner's control panel (fig 12-28) is located in the gunner's cockpit. Operation of the subsystem by the gunner is permitted by use of the PILOT OV-



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Figure 12-27. Pilot's armament control panel—M35.



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Figure 12-28. Gunner's armament control panel—M35.

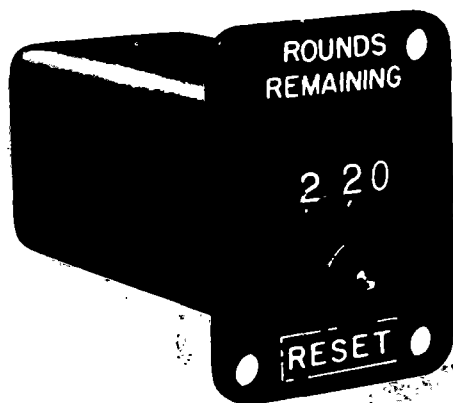


Figure 12-29. Rounds remaining counter.

ERRIDE switch located in the gunner's cockpit and the ARM/OFF switch on the control panel. An indicator light on the panel lights when the

subsystem is armed and under the control of the gunner.

s. Rounds Remaining Counter. The rounds remaining counter (fig 12-29) is located on the pilot's control panel and provides a digital indication of the number of rounds remaining in the system. As ammunition is fed into gun M195, feeder sprocket shaft trips a microswitch once each revolution (5 cartridges fired), sending a signal to the gun firing control unit. A divider circuit within the gun firing control unit signals the rounds remaining counter once for every two signals received from the microswitch, thus causing the rounds remaining counter to decrease the digital indication by ten. The counter must be manually reset to the actual ammunition load after each reloading.

12-6. Boresighting and Troubleshooting

For boresighting and troubleshooting procedures, see TM 9-1005-299-12.

Section III. XM120 ARMAMENT SUBSYSTEM

12-7. Description

The XM120 armament subsystem is an electrically-controlled, hydraulically-powered turret, containing the XM140 30mm automatic gun, mounted in the nose of the AH-1G helicopter. The subsystem consists of a turret assembly, turret control box, gun control box, and an ammunition feed system. Fire control will consist of a modified XM26 TOW missile sight or an advanced fire control consisting of a stabilized optical sight, laser range finder, ballistic computer, and helmet sights. Brief data for this subsystem is—

- a. Ammunition capacity—500 rounds.
- b. Weight—937 pounds.
- c. Maximum range—3,000 meters.
- d. Muzzle velocity—2,200 feet per second.
- e. Elevation—15°.
- f. Depression—40°.
- g. Traverse—110° right and left of longitudinal axis.

12-8. XM140 Automatic Gun

The XM140 30mm automatic gun (fig 12-30) is lightweight, electrically driven, and uses a fixed breech and reciprocating barrel driven by a control cam assembly concentric to the barrel. Components comprising a recoiling mass are the re-

ceiver, barrel, drum, and recoil breechblock assemblies. Components comprising a nonrecoiling mass are the feeder, clutch and drive, mount, and charger assemblies. The control cam assembly imparts reciprocating motion to the barrel assembly, which performs the locking, firing, and shell ejecting operations. The gun is timed to fire during the forward motion of the recoiling mass, which provides a partial cancellation of forces between gun and frame assembly. Provisions are made for the gun to automatically eject the shell, recharge, and reset itself for firing in the event of a misfire. The gun is remote controlled and is powered by a 28 vdc power source. Nominal rate of fire at 25v is 405 spm and muzzle velocity is 2,200 fps at 70° F. The rate of fire will vary directly as the voltage varies. Brief data for this subsystem is—

- a. Barrel length retracted—50.03 inches.
- b. Barrel length extended—60-53 inches.
- c. Weight—140 pounds.
- d. Maximum range—3,000 meters at 8° elevation.
- e. Muzzle velocity—2,200 feet per second.
- f. Peak recoil—1,600 pounds.
- g. Mode of fire—semiautomatic and automatic.
- h. Width of gun with feeder—12.125 inches; height—14.437 inches.

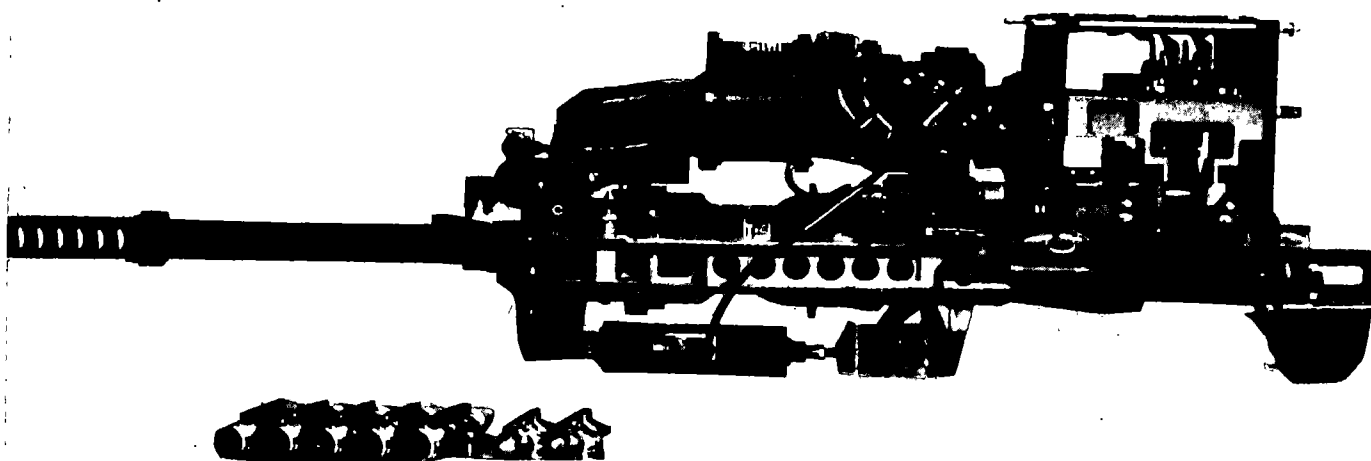


Figure 12-30. XM140 automatic gun.

- i. Rate of fire—425 shots per minute.
- j. Type of operation—cam actuated electric drive.
- k. Direction of feed—left or right, as assembled.
- l. Case ejection—in a downward direction.
- m. Link ejection—in the direction opposite feed.
- n. Method of feed—by metallic link belt (disintegrating).
- o. Center of gravity from rear of weapon system—17.687 inches (estimated).
- p. Recoil mechanism—dynamic type with soft mounting.
- q. Ammunition belt velocity—1.66 feet per second.
- r. Acceleration time—0.25 seconds.
- s. Motor rating—4 horsepower.
- t. Steady state current—120 amperes and 24 volts.
- u. Head space—fixed.
- v. Motor speed—8,400 revolutions per minute.
- w. Feeder speed—75 revolutions per minute.
- x. Cam speed—1,800 revolutions per minute.

Section IV. M18 AND M18A1 ARMAMENT PODS

12-9. Description

a. *7.62mm Machinegun Aircraft Armament Pod M18 or M18A1.* The armament pod (fig 12-31) is a lightweight, completely integrated weapon system incorporated into an aerodynamic design which permits its use on aircraft with speeds up to Mach 1.2. The armament pod contains its own power source and the electrically-driven multibarrel M134 machinegun has a firing rate of 2,000 or 4,000 shots per minute. Ammunition is fed to the M34 machinegun from a 1,500 round capacity drum, through a single-ended linkless system which is gear-driven by the gun rotor. Suspension lugs permit the armament pod to be installed on AH-1G helicopters or airplanes equipped with bomb racks.

b. *Main Components.* The following items are the main components and assemblies which make up the armament pod M18 or M18A1:

(1) *7.62 mm M134 machinegun.* The M134 machinegun (fig 12-32) is a lightweight, air-cooled, six-barrel weapon which revolves during operation. As the rotor turns, each of the six bolt assemblies, in turn, picks up a cartridge from the feeder MAU-57A/A, chambers the round, actuates the firing pin, and ejects the spent cases after firing. Firing is accomplished when the barrel is in the 12 o'clock position.

(2) *Electric drive assembly* (fig 12-32). The gun drive consists of an electric motor and gears which turn the gun. Power is transmitted through

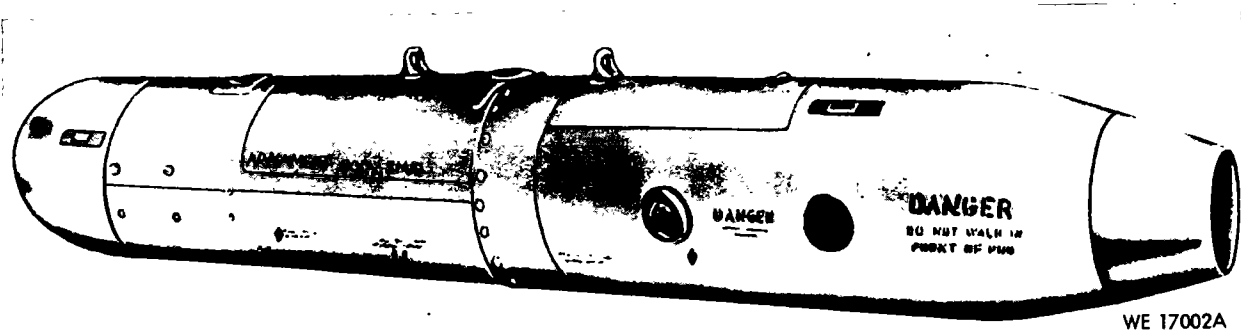


Figure 12-31. 7.62mm machinegun aircraft armament pod M18 or M18A1.

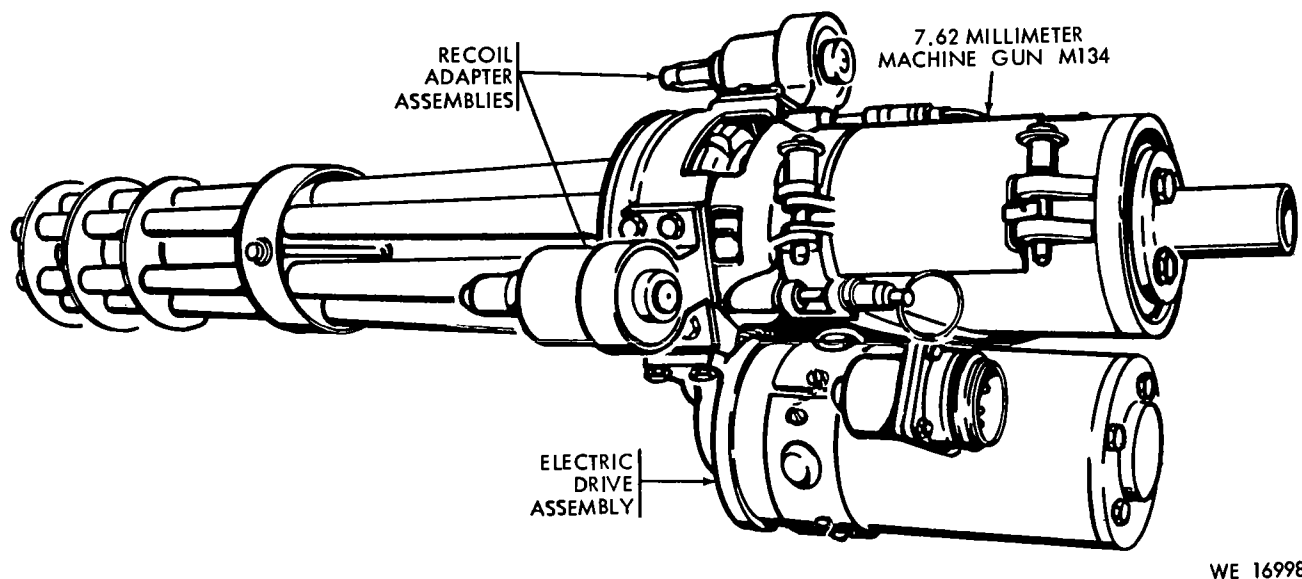


Figure 12-32. Gun assembly components.

a motor shaft spur gear and an idler gear to the front gear on the gun rotor assembly.

(3) *Recoil adapter assemblies* (fig 12-32). These spring-loaded plunger-type assemblies reduce the intensity of recoil and counterrecoil during firing.

(4) *Automatic gun feeder MAU-57A/A*. The ammunition feeder MAU-57A/A (fig 12-33) conveys cartridges from the exit unit assembly into the M34 machinegun during firing periods. It is driven directly by the rear gear on the gun rotor; however, when the trigger is released, the solenoid-actuated clearing section automatically prevents transfer of any additional rounds into the gun rotor.

(5) *Gun pod front fairing assembly*. The front fairing assembly consists of a stainless steel nose cap joined to an aerodynamic aluminum structure (fig 12-34). The nose cap provides an opening through which the M134 machinegun is

fired. A section at the top of the fairing assembly is cut away to accommodate the gun support assembly. Brackets in the lower section are used to store the ammunition loader assembly.

(6) *Loader assembly*. The loader assembly, operated by a handcrank, delinks belted ammuni-

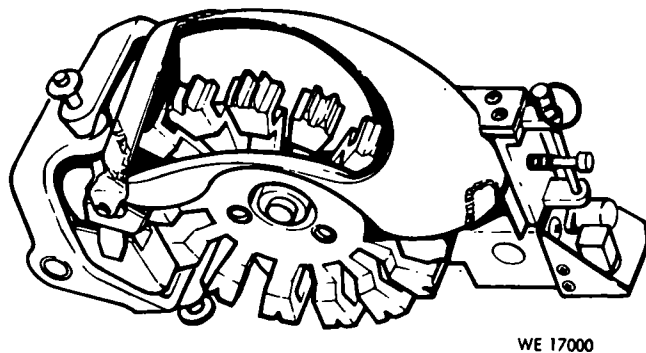
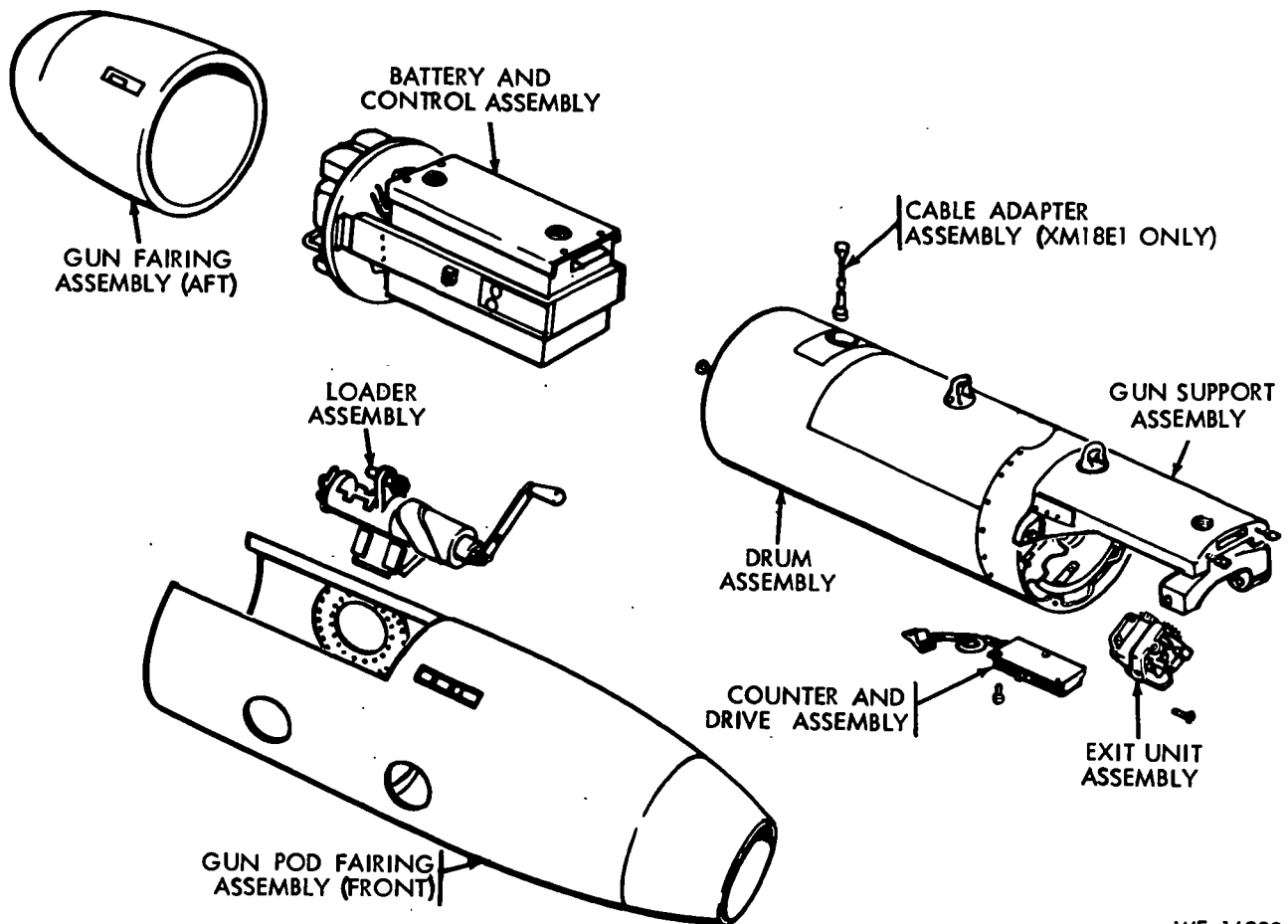


Figure 12-33. Automatic gun feeder MAU-57A/A.



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Figure 12-34. Pod assembly—main components.

tion, ejects the links, and transfers the cartridges through the exit unit assembly into the drum assembly for storage (fig 12-34).

(7) *Exit unit assembly.* The exit unit assembly consists of sprockets, shafts, and gears which remove the cartridge from the geared retainer partitions of the drum assembly and transfer them to the feeder MAU-57A/A (fig 12-33). It is gear-driven by the conveyor wheel of the feeder MAU-57A/A. The exit unit assembly works in reverse order during loading procedure and is then powered by the loader assembly.

(8) *Counter and drive assembly.* The rounds counter is a dual action drum-type recorder driven by a flexible shaft powered by the scoop disc ring gear of the drum assembly (fig 12-34). The reset portion indicates the number of rounds in the ammunition drum and is automatically reset as the armament pod is reloaded. The accumulative part records the total number of rounds fired.

(9) *Pod aft fairing assembly.* The aft fairing assembly is an aluminum structure which com-

pletes the streamline design of the armament pod (fig 12-34). It is secured by three latches which engage eyebolts in the outer drum structure and serves as a cover for the electrical system access area.

(10) *Battery and control assembly.* The control panel assembly and battery box assembly (fig 12-34) are mounted on retractable slides in the rear section of the drum. The electrical control system supplies power to the motor and provides pilot/copilot control of the gun operation by sequencing the electrical inputs to the motor and clearing solenoid during the firing cycle. The control system also supplies charge to the battery in use and maintains temperature control in the battery box.

(11) *Gun support assembly.* The gun support assembly is a beam and yoke which serves as a mount for the gun assembly (fig 12-34). A gun mount on the rear of the beam is on the centerline of the armament pod and provides the rear support for the M134 machinegun. The forward section of the beam contains two eyebolts which

secure the front fairing assembly. The rounds counter is fastened to the underside of the beam. The forward suspension lug and an electrical receptacle are located on the exposed section of the beam. The yoke is attached to the beam by a lead screw mechanism, permitting elevation/depression adjustment of the M134 machinegun. The arms of the yoke receive and support the recoil adapter assemblies of the gun assembly. A bore-sight block in the left arm of the yoke permits adjustment of the M134 machinegun in azimuth.

(12) *Drum assembly.* The drum assembly is the main structural component of the armament pod and forms the center section (fig 12-34). The partitions in the outer section provide storage facilities for ammunition which is moved in or out by fins of a rotating inner ammunition drum assembly. A scoop disc assembly is mounted on the ammunition drum assembly and acts to transfer the ammunition between the exit unit assembly and the drum assembly partitions. The drum cover assembly serves to support the ammunition drum assembly and provides mounting surface for the exit unit assembly and the rounds counter flexible shaft. The aft suspension lug and an alternate electrical outlet are located on the top of the drum assembly.

(13) *Cable adapter assembly.* This assembly adapts the electrical wiring of the armament pod M18A1 to the aircraft-to-armament pod cable assembly (fig 12-34).

c. Difference in Models.

(1) Early production models of the armament pod M18 had a fitting in the top of the drum assembly to accommodate a single (NATO) suspension lug.

(2) The first major change, armament pod M18A1, uses auxiliary aircraft power for more starting torque; a deenergizing solenoid for better clearing of rounds at a low rate of fire; and circuitry which permits a dual rate of 2,000 or 4,000 shots per minute for aircraft equipped with a two-detent cyclic stick trigger, or, for aircraft with single control, a switch for preselection of either rate.

d. Equipment.

(1) *Flash suppressor assembly.* The flash suppressor assembly is located on the barrel cluster of the M134 machinegun. This device reduces the flash resulting from secondary burning of the propellant gases when firing the M134 machinegun.

(2) *Bullet trap assembly.* The bullet trap assembly is a special tool designed as a safety device to prevent injury to personnel and damage to

equipment through accidental firing of the M134 machinegun. This device is placed over the barrel cluster in preparation of clearing the M134 machinegun.

12-10. Tabulated Data

Armament pod M18 and M18A1:

Length	85 in.
Diameter	12 in.
Weight—loaded	320 lb
Weight—empty	240 lb
Suspension	14 in. on center
Capacity	1,500 rounds
Temperature range	— 65° F to + 165° F
Ignition	28 vdc
Links	M13 (for loading only)
Feed system	Single-ended linkless with rotary conveyor
Gun and feed system drive	Motor-battery
Gun	7.62mm M134 machinegun
Weight	50 lb
Length	31.5 in.
Rate of fire:	
Slow (M18A1)	2,000 shots per minute
High	4,000 shots per minute
Burst length	3 seconds
Maximum burst	Full complement
Muzzle velocity	2,850 fps.
Cooling	Air
Barrel length	22 in.
Barrel weight	1 lb, 10 oz
Rotation	Counterclockwise
Boresight adjustment:	
Elevation/depression	+ 1° 30' to — 1° 30'
Azimuth	+ 1° 30' to — 1° 30'

12-11. Installation/Removal of Armament Pod

The following procedures are for installation of the armament pod to the aircraft. Unless otherwise indicated, removal is in reverse order of installation.

a. Remove front fairing assembly from armament pod (fig 12-35).

b. Inspect suspension lugs (fig 12-36) for correct installation and security. A minimum of five threads must be engaged in lug fitting. Also remove quick release pins from yoke of gun support assembly.

(1) Check that bomb rack hooks (fig 12-36) are open to accept armament pod.

(2) If not, insert rack release wrench or key (tool supplied with aircraft) in aperture and open rack hooks.

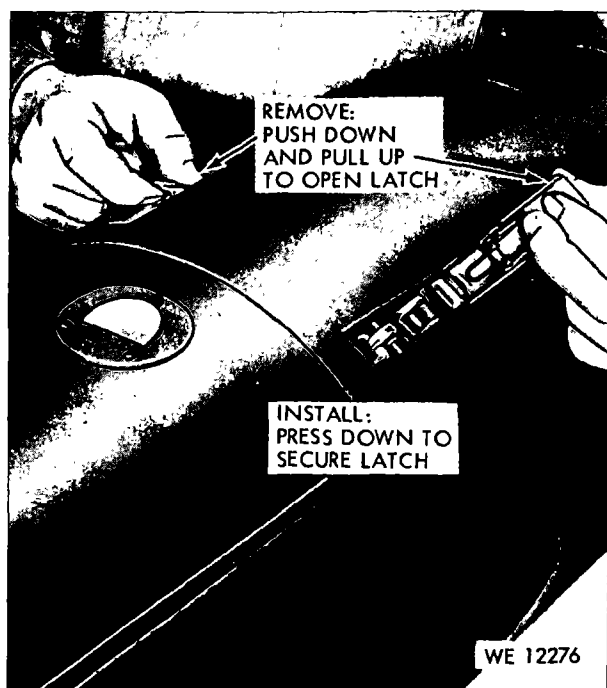


Figure 12-35. Installing or removing front fairing assembly.

c. Loosen rack sway brace pads. Lift armament pod into position under inboard pylon and close rack hooks with wrench or key (fig 12-36).

Note. A minimum of four men are required to lift armament pod.

d. Adjust front sway brace pads simultaneously, then both rear sway brace pads. Tighten jam nuts securely.

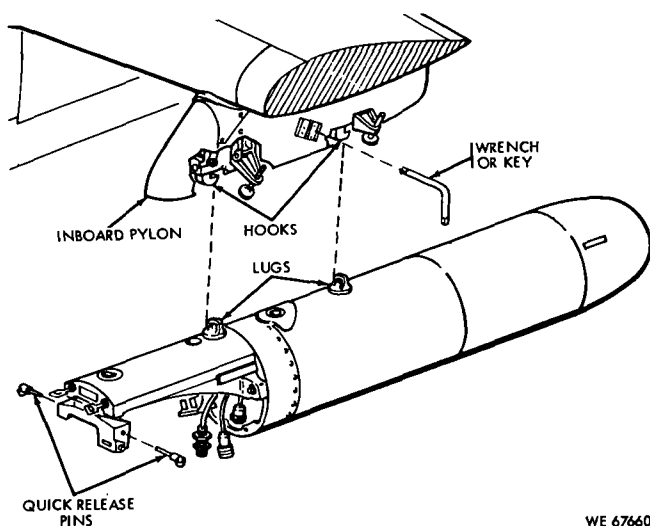


Figure 12-36. Installation/removal of armament pod on inboard pylon of wing.

Note. Do not adjust both left or both right sway brace pads at the same time.

Note. Accomplish boresighting procedures before installing flash suppressor.

e. Install flash suppressor assembly.

(1) Remove screw from barrel clamp assembly and remove barrel clamp assembly (A, fig 12-37).

Note. If barrel clamp assembly is tight on gun barrels, tap lightly with a soft-faced hammer to release.

(2) Fit bolt into cluster (B, fig 12-37).

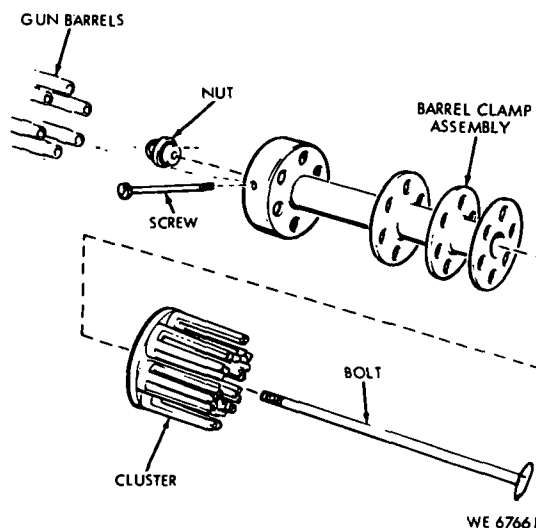
(3) Position cluster and bolt on face of barrel clamp assembly.

(4) Screw on nut two or three turns.

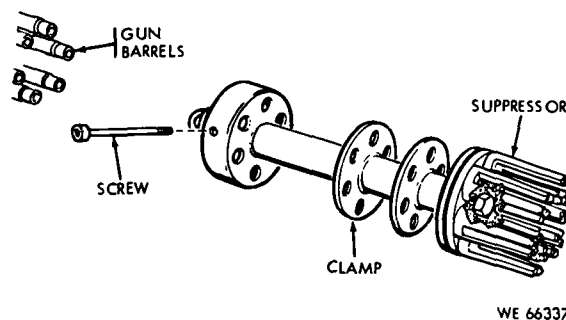
(5) Aline loop on nut with screw hole in barrel clamp assembly.

(6) Insert screw in barrel clamp assembly and tighten just enough to hold nut.

(7) Turn cluster and bolt into solid contact with barrel clamp assembly.



A. REMOVE SCREW FROM BARREL CLAMP ASSEMBLY— THEN REMOVE BARREL CLAMP ASSEMBLY.



B. FIT BOLT INTO CLUSTER.

Figure 12-37. Installation/removal of flash suppressor assembly.

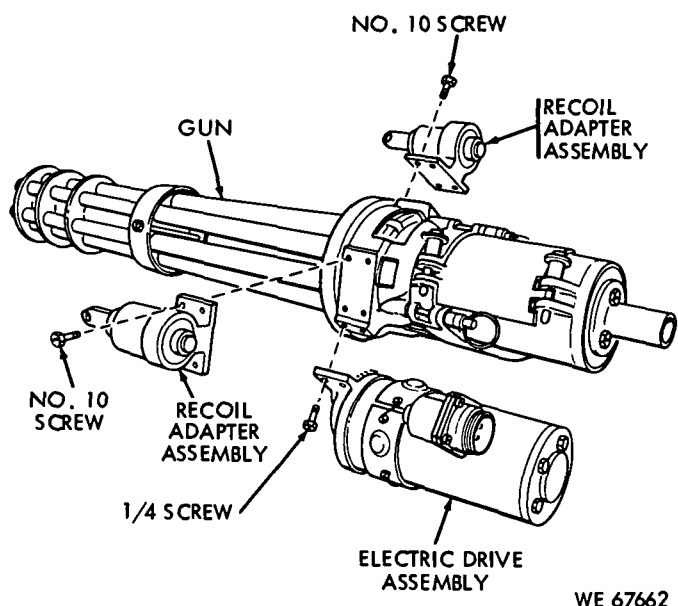


Figure 12-38. Assembly/disassembly of recoil adapter assemblies and electric drive assembly.

(8) Tighten cluster to align with barrel holes (about $\frac{1}{16}$ turn maximum).

(9) Remove screw from barrel clamp assembly.

(10) Install barrel clamp and cluster on gun barrels. Secure with screw.

Note. Turn screw until head is flush with barrel clamp assembly, then tighten one-half turn.

f. Assemble recoil adapter assemblies and electric drive assembly to the M134 machinegun (fig 12-38). Install gun assembly in gun support assembly of armament pod as shown in figure 12-39

and 12-40. Secure with quick-release pins which were removed in *b* above.

Caution: Use care when fitting the two metal tabs of feeder MAU-57A/A on the exit unit assembly. If tabs are bent, cartridges are allowed to enter feeder MAU-57A/A out of alignment. This will result in jams and possible damage to components.

g. Install feeder MAU-57A/A by positioning and securing as shown in figures 12-41 and 12-42.

Note. Before installing feeder MAU-57A/A to exit unit and gun assemblies, refer to table 12-3 for timing instructions.

Table 12-3. Procedure for Timing M134 Machinegun and Armament Pod Assemblies

*Step	Timing procedure
1	Depress drum cover assembly timing pin and rotate ammunition drum assembly until timing pin can be fully depressed. With drum cover assembly pin fully depressed, determine that exit unit assembly timing pin can also be fully depressed. If exit unit assembly timing pin cannot be fully depressed within one complete rotation of the drum, rotate gears of exit unit assembly until its timing pin can be completely depressed.*
2	Depress gun timing pin and rotate gun barrels until gun timing pin can be fully depressed.*
3	Depress feeder timing pin and rotate feeder MAU-57A/A until timing pin can be fully depressed. Hold pin in fully depressed position and install feeder to exit unit and gun assemblies.
4	Check that all four timing pins—drum cover assembly, exit unit assembly, feeder MAU-57A/A, and M134 machinegun—can be fully depressed. Also make certain that all timing pins return to neutral (disengaged) position when released.

*After timing procedure is accomplished in each step, do not rotate items until after all four steps are completed.

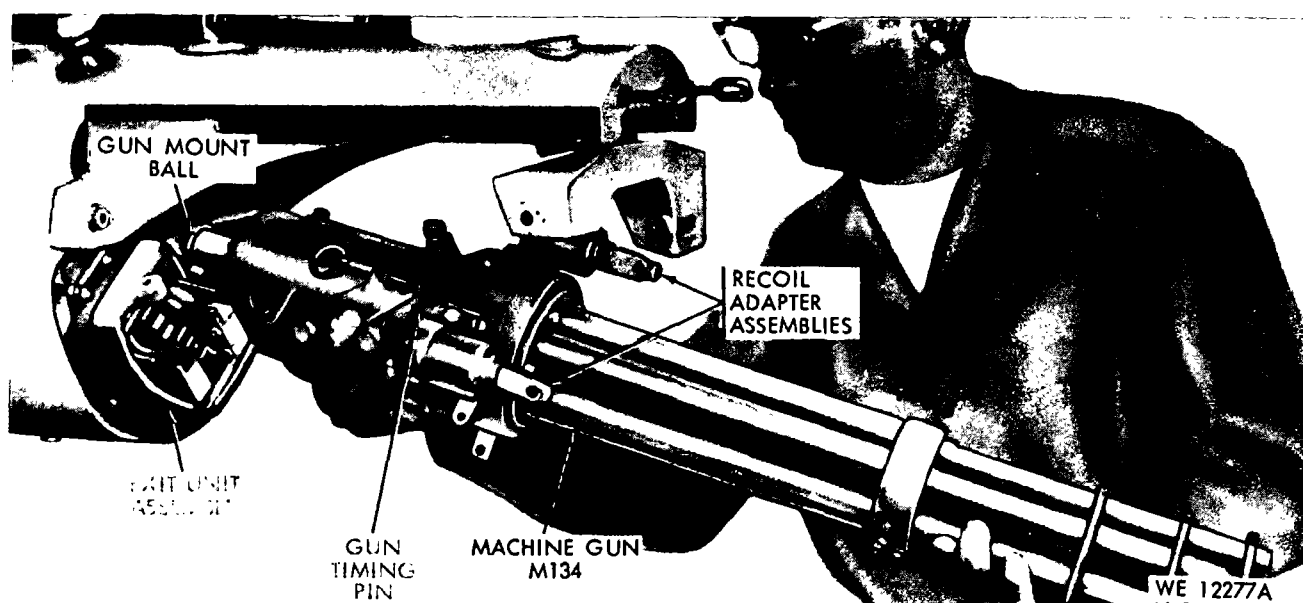


Figure 12-39. Positioning rear gun support on gun mount ball.

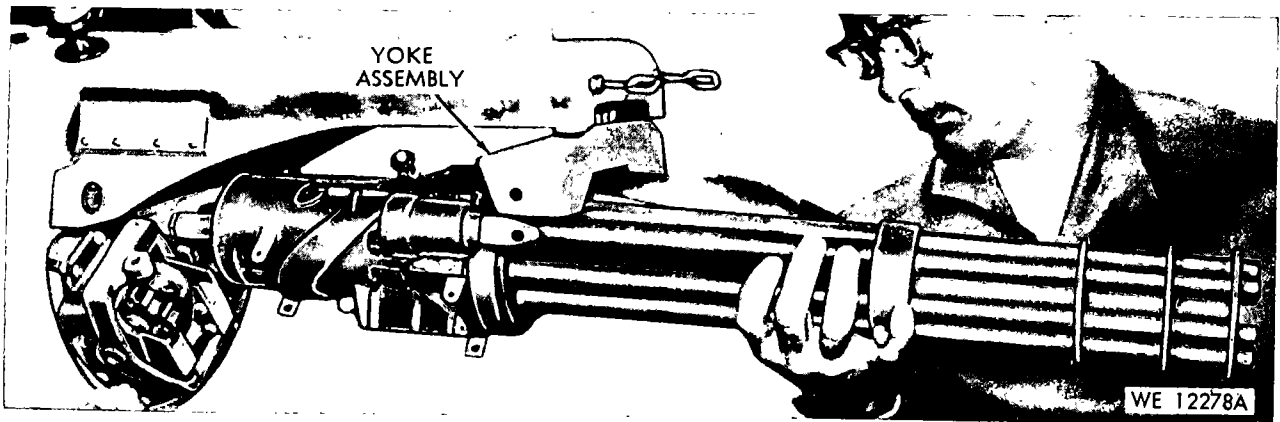


Figure 12-40. Alining recoil adapter assemblies with mating holes in yoke assembly.

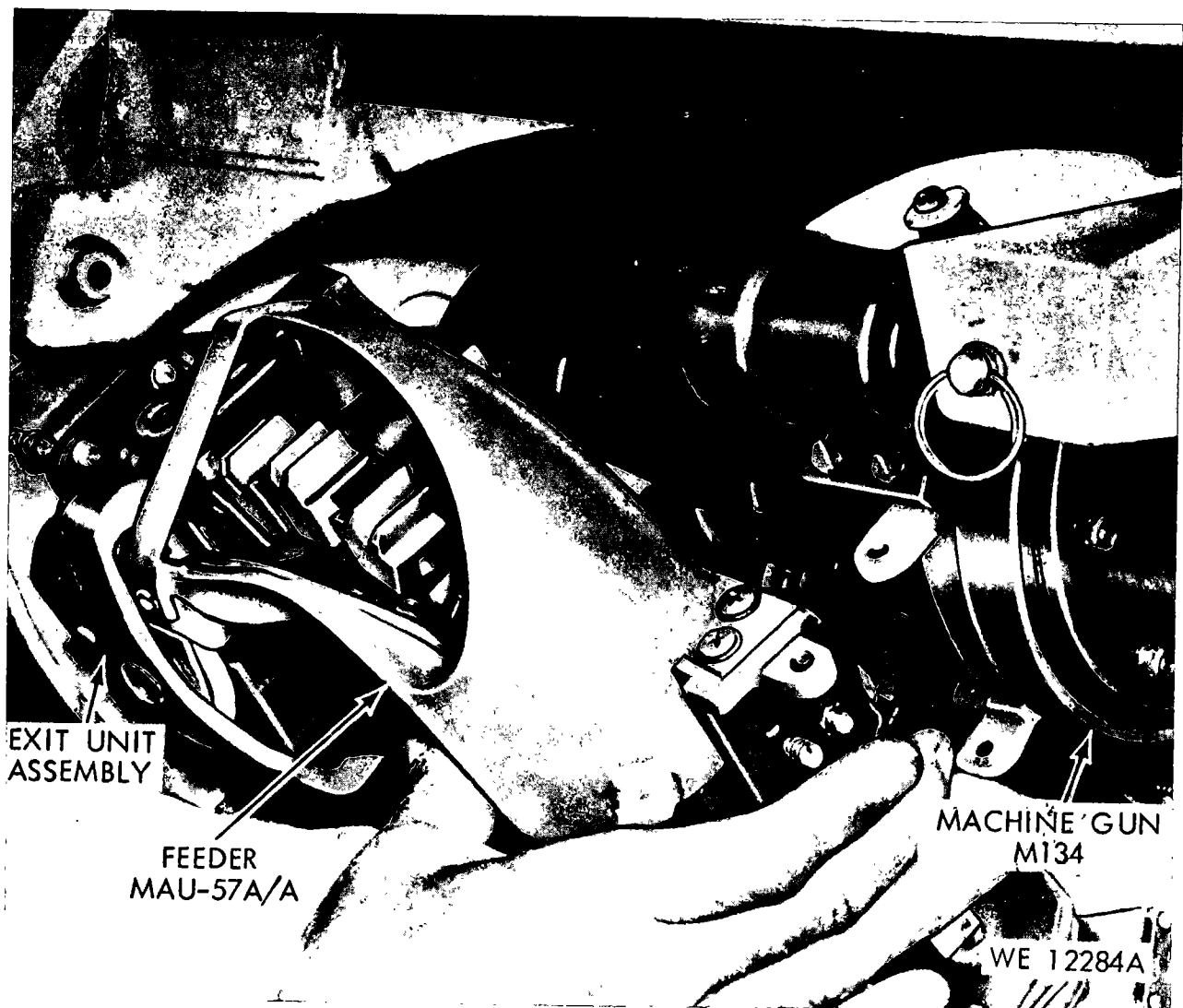


Figure 12-41. Positioning feeder MAU-57A/A.

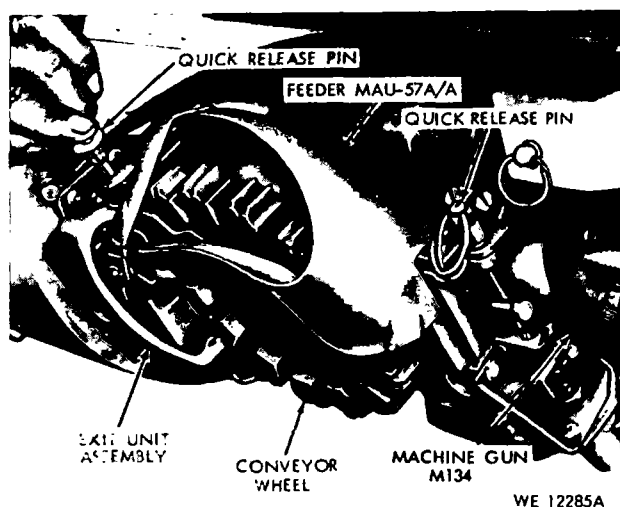


Figure 12-42. Installing feeder MAU-57A/A.

h. Connect drum assembly cable connectors P4 and P3 to connectors on gun drive motor and feeder solenoid.

i. Install front fairing assembly to armament pod (fig 12-35).

j. Connect aircraft-to-armament pod cable assembly to aircraft and to armament pod.

12-12. Timing

Timing pins (fig 12-39 and 12-43) are provided on the drum cover assembly, exit unit assembly, feeder MAU-57A/A, and M134 machinegun. The pins are used to insure that these items are synchronous in operation when properly installed and timed as outlined in table 12-3.

12-13. Controls and Instruments

a. Table 12-4 describes the various controls and instruments and provides sufficient information to insure proper operation of the armament pod.

b. Controls for firing are located within the pilot's or gunner/copilot's compartment of the applicable aircraft. Refer to the operator's manual of the aircraft for description and operating instructions of these controls.

12-14. Operational Check

Warning: Do not walk in front of armament pod. Check pilot's and gunner's cockpits to insure that all armament switches are OFF and all applicable circuit breakers are pulled OUT. Disconnect the aircraft-to-armament pod cable assembly at pod.

To determine if the armament pod is properly installed and serviceable—

a. Remove front fairing assembly from armament pod (fig 12-35).

Warning: Do not perform operational check with live ammunition in any component of the armament pod. Refer to TM 9-1005-257-12 and unload any live ammunition.

b. In accordance with loading instructions in TM 9-1005-257-12, load approximately 100 dummy rounds of ammunition into the drum assembly.

Caution: Do not use corrugated case dummy cartridges or spent cartridge cases. Either will cause jams. Make sure safing sector is installed.

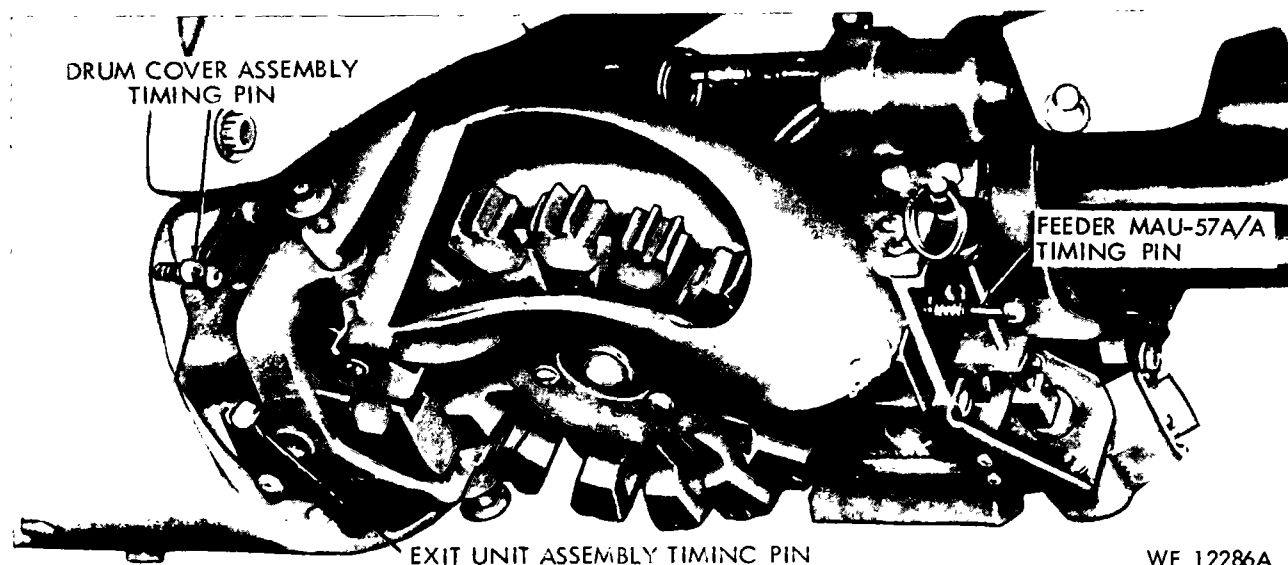


Figure 12-43. Feeder MAU-57A/A, exit unit assembly, and drum cover assembly timing pins.

Table 12-4. Controls and Instructions

Control or Instrument	Function	Reference
Timing pins.....	There are four timing pins used to establish the firing cycle of the M134 machinegun.	Table 12-3; fig 12-39 and 12-43.
Safing sector.....	When safing sector is removed, bolt assemblies cannot be cammed into battery, or firing pins cocked and released by rotation of gun mechanism.	
Counter and drive assembly.....	The four-digit indicator (ROUNDS IN POD) shows the number of rounds in the armament pod. The six-digit indicator (TOTAL ROUNDS IN POD) shows the total rounds that have previously been fired from the armament pod. Reset knob is used to set the ROUNDS IN POD indicator to zero reading when loading armament pod.	Fig 12-44.
Battery charger switch.....	A two-position (OFF-AUTO) toggle switch—located on lower portion of armament pod M18 control panel and on upper portion of armament pod M18A1 control panel—permits battery charging when placed in AUTO position.	
Battery heater switch.....	A two-position (OFF-AUTO) toggle switch—located on lower portion of armament pod M18 control panel and on upper portion of armament pod M18A1 control panel—permits heating the battery at zero degrees Fahrenheit when placed in AUTO position.	
Firing rate selector switch.....	A two-position (HIGH-LOW) toggle switch is located on the upper portion of the armament pod M18A1 control panel assembly. Placed in LOW position, the gun fires at 2,000 shots per minute; in HIGH position, the gun fires at 4,000 shots per minute. If aircraft has high and low rate trigger switch capability, place firing rate selector switch of armament pod in the HIGH position; otherwise place switch in the desired rate position.	
Power start field switch.....	Two-position (ACFT-BAT) toggle switch on upper portion of armament pod M18A1 control panel. When placed in BAT position, armament pod battery supplies the electric power for weapon operation. Placed in the ACFT position, the aircraft battery will supply a momentary surge of current to increase starting torque of weapon.	
Battery charged indicator light.....	Illuminates when battery charged switch is placed in AUTO position; at the time, battery becomes fully charged.	
Battery charging indicator light.....	Illuminates when battery charger switch is in AUTO position, indicating that battery is being charged.	
Azimuth adjusting knob (boresighting).....	Permits firing barrel to be moved in azimuth 1.5° right and 1.5° left—total adjustment of 3°.	Fig 12-45.
Elevation adjuster (boresighting).....	Permits firing barrel to be elevated 1.5° and to be depressed 1.5°—total adjustment of 3°.	Fig 12-46.

c. Manually rotate barrel cluster of M134 machinegun to feed dummy ammunition through exit unit assembly and into the feeder MAU-57A/A.

Note. Manually cycle a total of approximately 20 rounds through the components during the checks outlined in d through e below.

d. Manually hold down clearing solenoid of feeder MAU-57A/A and observe if the rounds enter the M134 machinegun smoothly.

e. Release feeder clearing solenoid and observe that rounds clear through the bottom of feeder MAU-57A/A.

f. Plug in aircraft-to-armament pod cable, activate electrical power circuits in aircraft, and depress trigger switch and release immediately. Gun barrels should rotate for approximately one-fourth second after trigger is released.

Caution: Gun operation (dry firing) shall be held to a minimum to avoid damaging firing pins. Also the high speed obtained by an empty gun, when electrically driven, may damage moving parts.

g. Deactivate electrical armament pod control in aircraft, disconnect aircraft-to-armament pod

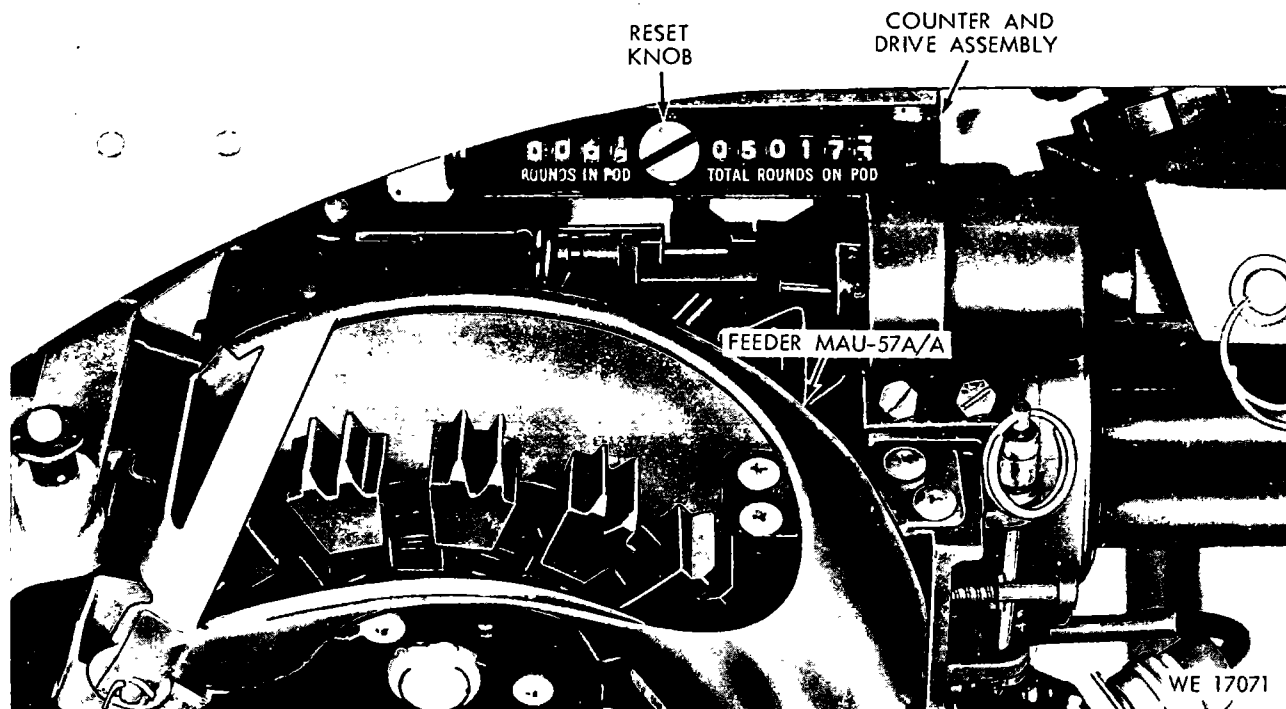


Figure 12-44. Counter and drive assembly.

cable assembly from armament pod, and make sure all dummy ammunition has been removed from the armament pod.

12-15. Boresighting

This paragraph contains the procedures required to obtain accuracy of fire by adjusting the axis of the bore of the weapons in relation to the aircraft sighting equipment.

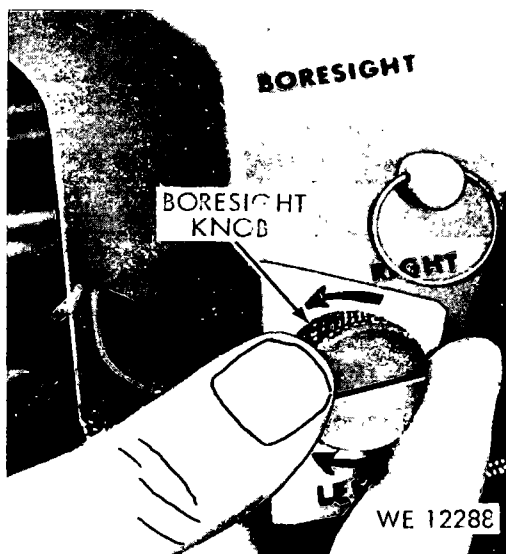


Figure 12-45. Adjusting M134 machinegun in azimuth.

Note. Remove flash suppressor assembly from M134 machinegun (para 12-11e) before attempting to boresight armament pod.

a. Distant Aiming Point Method.

Warning: Clear the armament pod of all live ammunition.

(1) Select a well defined point target at least 1,000 meters distant and in line with centerline of helicopter.

(2) Park helicopter in a relatively level position. Locate helicopter to superimpose reticle of reflex sight XM73 on distant aiming point (TM 9-1090-203-12).

(3) Check that armament pod is properly secured in bomb rack and sway braces are properly adjusted and tightened.

(4) Remove two quick release pins (fig 12-42) securing conveyor wheel support to exit unit assembly and move conveyor wheel to loading (forward) position.

(5) Unlock elevation boresight adjuster and azimuth boresight knob by loosening locking screws.

Note. Elevation locking setscrew is located in the center of the yoke assembly above the elevation adjuster. Azimuth locking setscrew is located on the bottom side of the yoke assembly directly beneath the azimuth boresight knob.

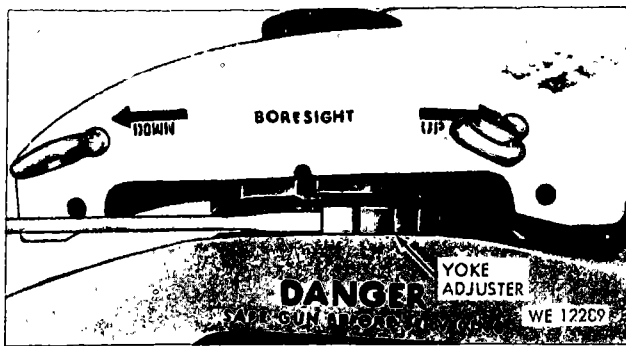


Figure 12-46. Adjusting M134 machinegun in elevation.

(6) Set elevation and azimuth boresight adjustments (fig 12-45 and 12-46) to center point of adjustment limits.

(7) Rotate barrel cluster until gun timing pin can be fully depressed.

(8) Insert boresight adapter (fig 12-47) into muzzle of barrel which is in firing (12 o'clock) position and install boresight.

(9) Adjust elevation and/or azimuth boresight adjustment until telescope crosshairs are on point target. Tighten elevation and azimuth locking setscrews to hold boresight adjustment.

(10) Check that aircraft sighting equipment reticle is still superimposed on target.

(11) Remove boresight and adapter from the gun barrel.

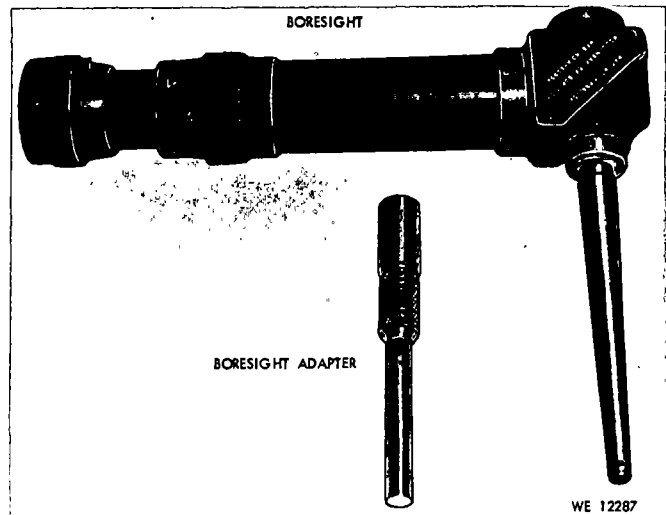


Figure 12-47. Boresight and boresight adapter.

(12) Time exit unit assembly and feeder MAU-57A/A (table 12-3). Move conveyor wheel to firing (rearward) position and secure with two quick release pins.

b. Boresight Target Method.

Note. In the following procedure, one person remains in pilot's cockpit to see that the reticle image of reflex sight XM73 stays on boresight target.

Note. If armament pod boresighting is a continuation of boresighting armament subsystem M28A1, aircraft and boresight target will be in correct relative position. Proceed with step (4) below.

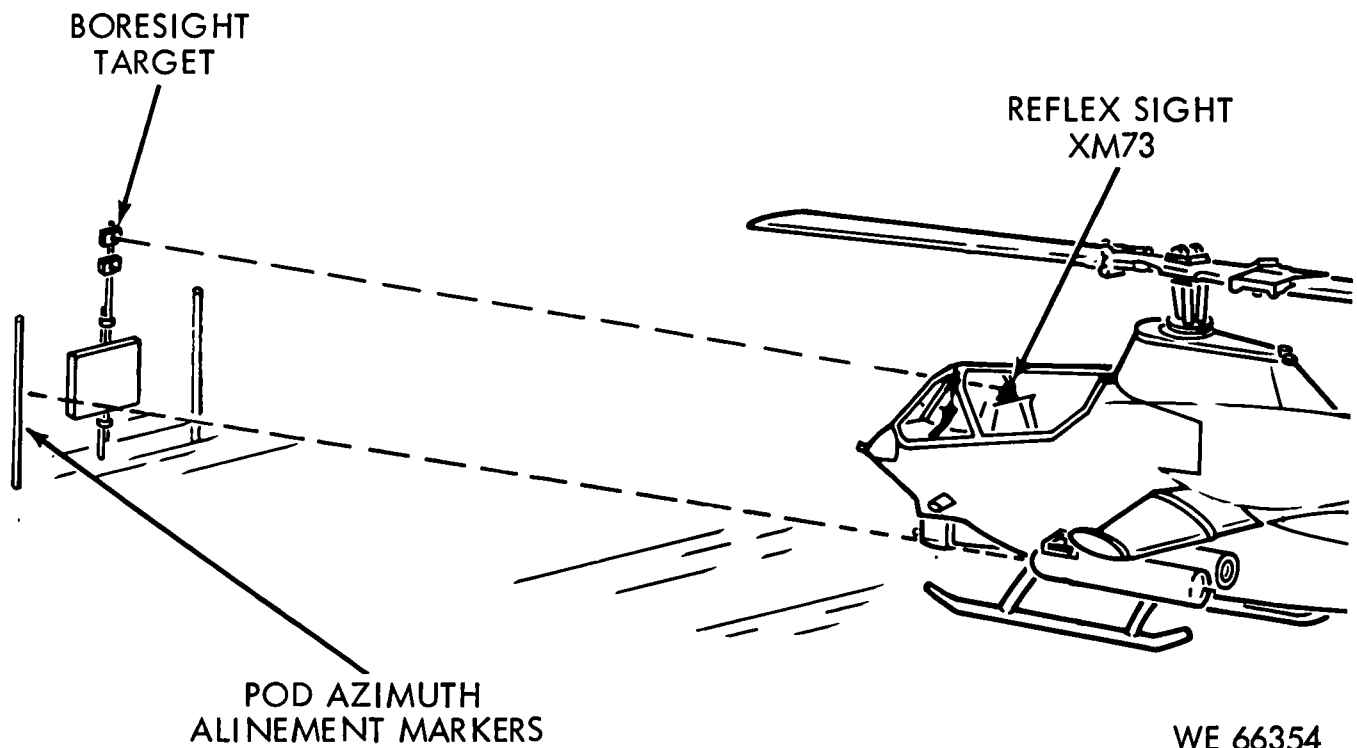


Figure 12-48. Boresight target position.

- (1) Position aircraft and boresight target as shown in figure 12-48, with boresight target about 100 feet in front of the helicopter.
- (2) In pilot's cockpit, set elevation/depression and range potentiometer scales on reflex sight XM73 to zero. Turn on reticle light filament selector switch.
- (3) Move boresight target until reticle image is on pilot's sight boresight position, as shown in figure 12-49.
- (4) Measure 42.5 inches left and right from the helicopter centerline on the boresight target. Set up an alinement marker (stake) at each point.
- (5) Mark a vertical line on each marker to show the 42.5-inch distance.
- (6) Repeat procedures in a(3) through (8) above.

Note. In the following procedures, use the mcachinist's protractor from the combination square of the aircraft armament repairman's basic tool set.

- (7) Place protractor on barrel clamp of M134

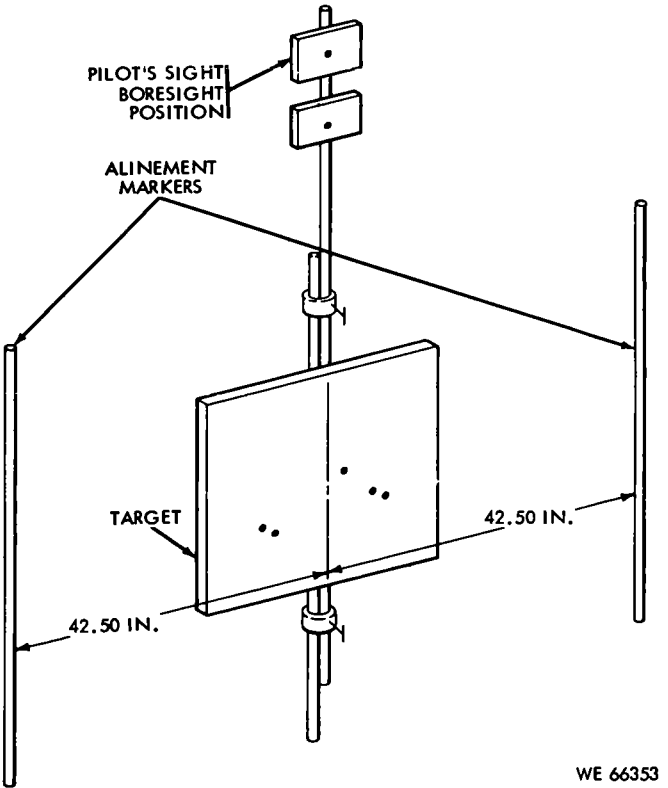
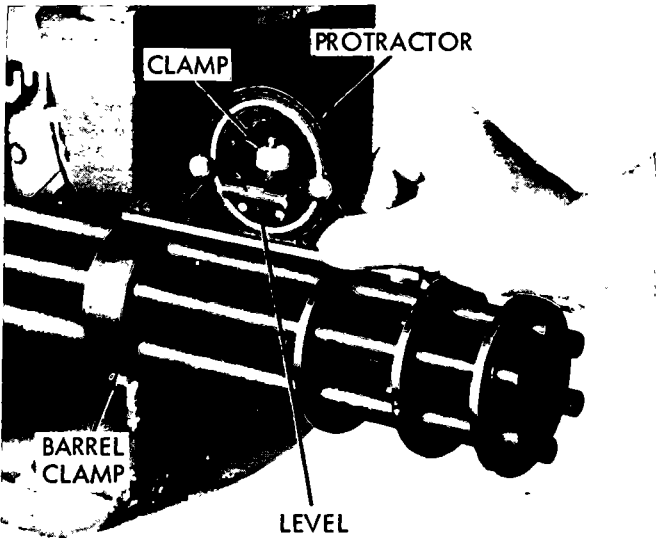
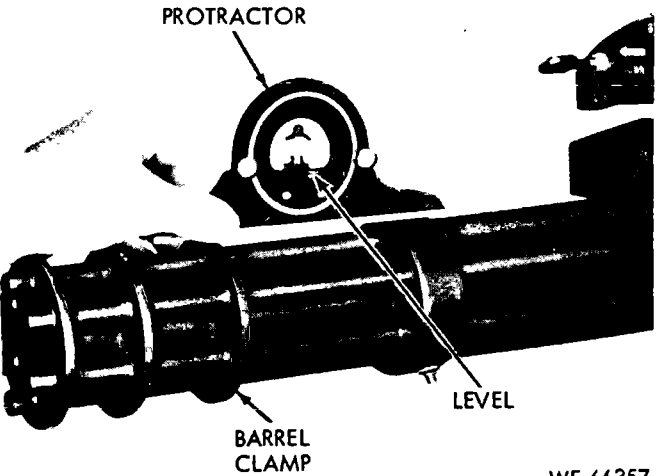


Figure 12-49. Boresight target and alinement markers.



WE 66356

Figure 12-50. Protractor on M134 machinegun in M28A1 armament subsystem.



WE 66357

Figure 12-51. Protractor on M134 machinegun in armament pod.

machinegun in armament subsystem M28A1 (fig 12-50).

- (8) Center bubble in level and tighten protractor clamp.
- (9) Move protractor to barrel clamp of M134 machinegun in armament pod (fig 12-51).

Table 12-5. Troubleshooting

Malfunction	Probable cause	Corrective action
GUN ASSEMBLY		
Fails to rotate or fire.....	Loose or defective connection between electric cable assembly and electric drive assembly.	Check connection.

Table 12-5. Troubleshooting—Continued

Malfunction	Probable cause	Corrective action
Gun Assembly—Continued		
	Low or discharged battery.....	Charge battery.
	Defective electric drive assembly.....	Replace.
	Damaged cartridge in M134 machinegun.....	Clear M134 machinegun and check ammunition for damaged cartridges.
	Foreign material in barrel chamber(s)....	Remove material and clean barrel(s) and chamber(s).
	Damaged bolt assemblies.....	Replace.
	Timing pin not released.....	Check pin (also check those on drum assembly, exit unit assembly, and feeder).
	Improper timing between feeder MAU-57A/A, M134 machinegun, and exit unit assembly.	Check timing.
	Improperly adjusted or damaged counter and drive assembly.	Adjust. Notify direct support if repair is required.
Rotates but will not fire.....	Damaged or unserviceable cartridges....	Clear M134 machinegun and check ammunition.
	Broken firing pin.....	Replace.
	Broken firing pin spring.....	Replace.
	Damaged bolt heads.....	Replace.
	Burred firing pins or bolt heads.....	Remove burs.
Fires but rate is low.....	M134 machinegun dirty or not properly lubricated or both.	Clean and lubricate.
	Burred or damaged bolt assemblies.....	Inspect and remove burs; repair or replace bolt assemblies.
	Burred or damaged camtracks in rotor assembly or housing.	Inspect and remove burs. Notify direct support, if damaged.
Stops firing.....	Damaged cartridges.....	Clear M134 machinegun.
	Bolt head separated from bolt assembly..	Remove bolt head and replace firing bolt head assembly.
	Damaged rotor assembly.....	Replace M134 machinegun.
	Loose or defective connection between electric cable assembly and electric drive assembly.	Check connection.
Fails to feed.....	Damaged or broken guide bar.....	Replace.
	Bent or broken fingers on gun housing....	Notify direct support.
	Damaged or broken extractor on bolt head.	Replace firing bolt head assembly.
Fails to extract.....	Damaged or broken extractor on bolt head.	Replace bolt head.
	Bent or broken guide bar allows round to feed ahead of bolt assembly.	Replace guide bar.
	Damaged rim on cartridge.....	Clear M134 machinegun. Inspect for bent or damaged parts which would damage rim of cartridge.
Fails to eject.....	Bent or broken guide bar.....	Replace guide bar.
	Damaged gun housing assembly.....	Notify direct support.
Excessive dispersion of bullets.....	Barrels—heat warped or excessively worn rifling.	Replace.
	Loose barrel clamp assembly allows barrel movement.	Tighten barrel clamp.
FEEDER		
Fails to rotate or feed.....	Timing pin not released.....	Check pin (also check those on drum assembly, exit unit assembly, and gun assembly).
	Improper timing between feeder MAU-57A/A, M134 machinegun, etc.	Check timing.
	Damaged cartridges.....	Remove.

Table 12-5. Troubleshooting—Continued

Malfunction	Probable cause	Corrective action
Feeder—Continued		
Low firing rate.....	Loose or defective connection in cable assembly of electrical (clearing) solenoid.	Check connection.
	Defective clearing solenoid.....	Replace.
	Feeder MAU-57A/A not properly lubricated.	Clean and lubricate.
	Foreign matter in feeder MAU-57A/A.....	Remove.
Firing stops.....	Burred, bent, or damaged parts in feeder MAU-57A/A.	Repair or replace as required.
	Damaged parts in feeder MAU-57A/A.....	Repair or replace.
POD ASSEMBLY		
Firing stops.....	Low or discharged battery.....	Charge battery.
	Timing pins in exit unit assembly and drum assembly not released.	Check pin (also check feeder and gun timing pin).
	Damaged cartridges in drum assembly.....	Remove.
	Defective timing, gun, or burst module assembly.	Replace.
	Damaged parts in exit unit assembly or drum assembly.	Repair.
Low rate of fire.....	Low charge in battery.....	Charge battery and/or replace cell(s) as required.
	Foreign matter in drum assembly.....	Remove.
Excessive dispersion of bullets.....	Timer module assembly defective.....	Replace.
Fails to operate.....	Defective power module.....	Replace.

(10) Adjust elevation boresight adjustment (fig 12-46) until level bubble is centered.

(11) Adjust azimuth boresight adjustment until boresight vertical crosshair is on line on alinement marker.

(12) Repeat procedures of a(10) through (12) above.

(13) Remove boresight target and alinement markers. Turn off reticle light filament selector switch.

12-16. Troubleshooting

Table 12-5 is intended as a guide in troubleshooting. The table does not cover all possible malfunctions that may occur. Only the more common malfunctions are listed.

Warning: Do not attempt to troubleshoot an armament pod containing live ammunition. Clear gun and remove ammunition before proceeding.

Section V. TOW ARMAMENT SUBSYSTEM

To be published when information on TOW armament subsystem is available.

CHAPTER 13

HELICOPTER ARMAMENT SUBSYSTEM GUNNERY TRAINING

Section I. RANGE REQUIREMENTS

13-1. General

Range requirements are based on the types of aircraft and weapons subsystems to be used on the range, the purpose of the range (i.e., initial or annual qualification), and whether or not qualified instructor pilots are aboard each aircraft to control the firing.

13-2. Ranges

a. Recommended Ranges. Recommended ranges for aviator firing exercises are shown in A and B of figure 13-1. The maximum absolute altitude above the terrain from which armament subsystems may be fired will not exceed 2,000 feet. When the aircraft is in straight and level flight, the maximum weapon limit for firing will not exceed 0° elevation and 45° depression. Range firing provides the gunner with training in identifying, acquiring, and shooting at targets. Helicopter flightpaths and the firing lane must be clear of other range impact areas. Diagrams should be obtained to show adjacent aerial gunnery ranges, artillery ranges, and small arms ranges. Written range safety regulations and range firing and safety standing operating procedures must be readily available at each installation. The surface danger area (*b* below) provides for the following situations:

(1) *Plan 1.* Where firing is conducted with relatively inexperienced pilots under minimum control, plan 1 of distance X will be used. Area G will be used in the surface danger area.

(2) *Plan 2.* Where firing is conducted with relatively experienced pilots and when a qualified instructor pilot is on board, area G may be eliminated and Plan 2 of distance X will be used.

b. Surface danger areas. Guidance for the surface danger areas is shown in figure 13-1. Table 13-1 contains recommended range dimensions for various weapon systems. Each surface danger area is divided into the following major components:

(1) *Firing lane.* The area of the range within which a helicopter mounted weapon is fired is

called the firing lane. The firing lane has lateral boundaries extending perpendicularly from each end of the start-fire line (SFL) to each end of the cease-fire line (CFL). Targets may be engaged beyond the CFL but firing must cease at the CFL. To permit target engagement at maximum effective range, the target lane (part of the firing lane) extends beyond the CFL.

(2) *Impact area.* All rounds must impact into the impact area. The impact area extends down-range a distance of X meters (fig 13-1).

(3) *Area G.* Area G (fig 13-1) is required for aerial firings of inexperienced pilots and/or gunners. This area may not be required when qualified instructor pilots are controlling fires from each helicopter (plan 2, *a*(2) above). Area G is not required when firing is conducted from a static position (e.g., helicopter on ground).

(4) *Buffer zone (areas A and B).* The buffer zone surrounds the impact area to provide a margin for error. Area A begins at each end of the start-fire line and extends out at a 25° angle from the impact area (or area G, if required) until it reaches the width specified for the type of ammunition in use. The boundary then parallels the boundaries of the impact area. Area B is adjacent to area A and surrounds the rest of the impact area.

(5) *No-fly line.* The aircraft must make a turn before reaching the no-fly line to prevent penetrating a designated area (other range impact areas, restricted area, etc.).

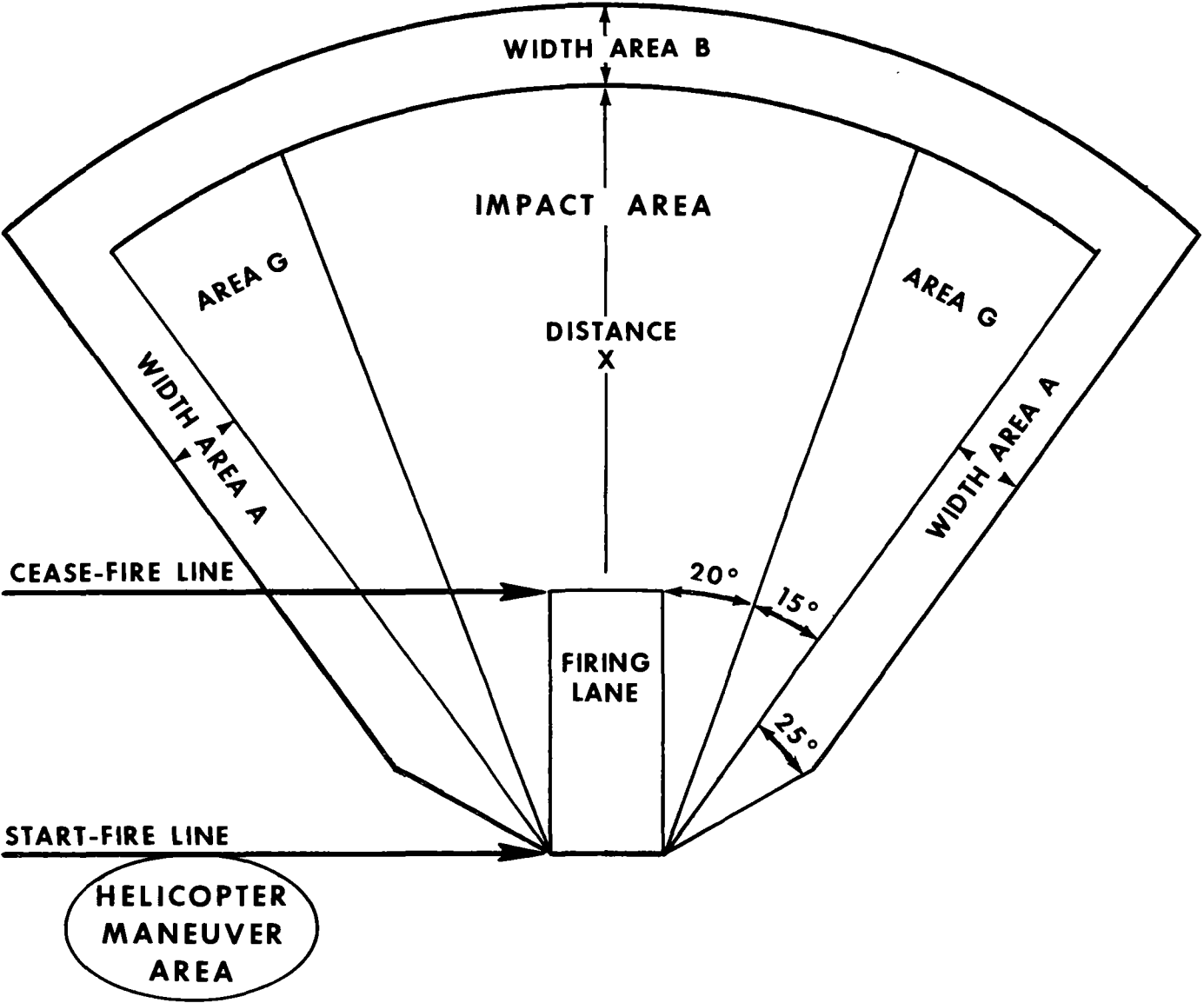
c. Targets. All targets should be placed within the firing lane or an extension of the firing lane. Available equipment and funds will determine the types of targets to be used. The three types of targets are—

(1) *Hard targets.* Hard targets, e.g., tank hulls and/or armored personnel carrier hulls, make very durable and good targets for initial training. These targets should be painted in different bright colors. One of each of these targets should be located at close, mid, and extreme ranges.

(2) *Silhouettes.* Silhouettes make very good

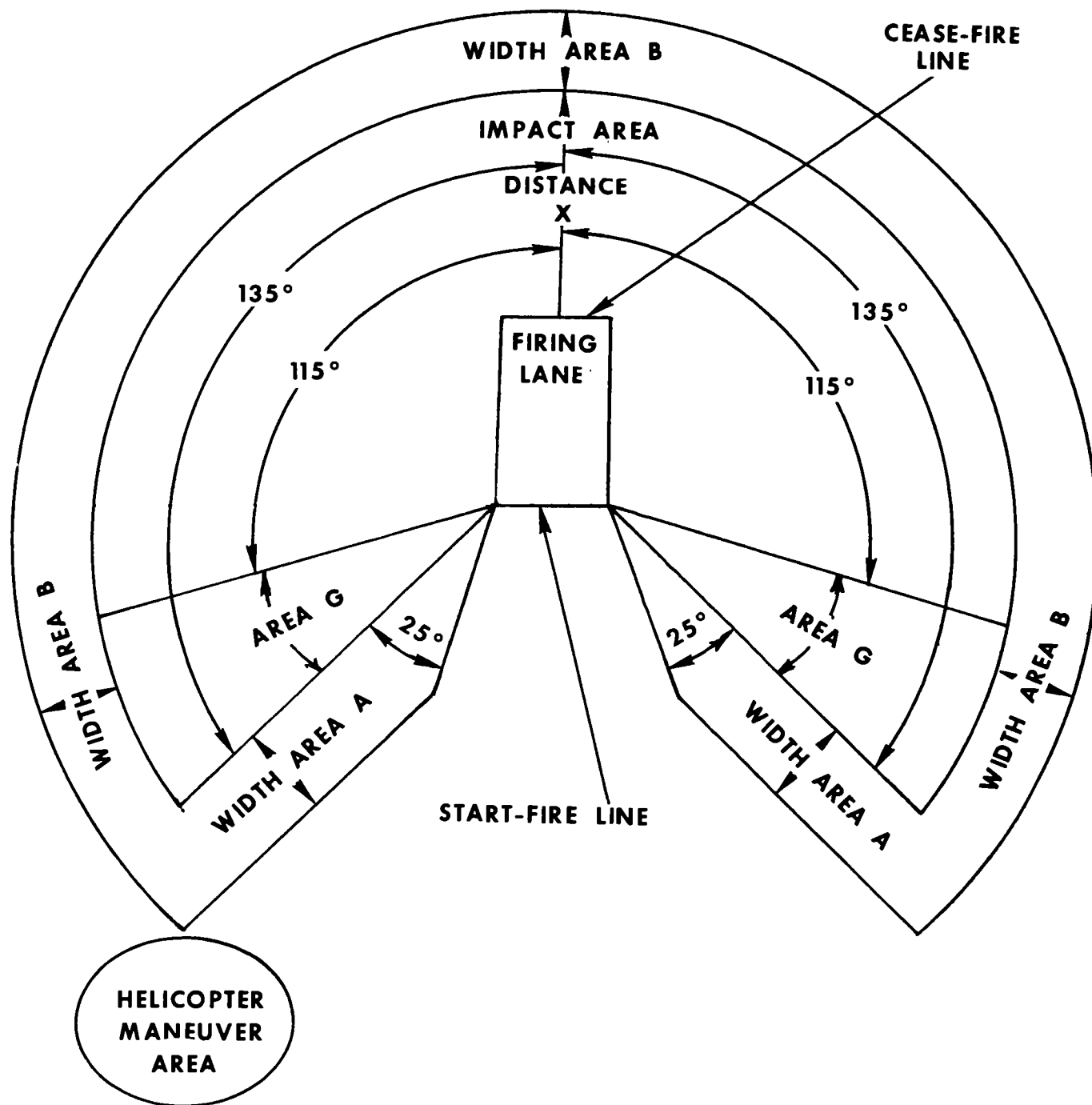
Table 13-1. Surface Danger Area (Aerial Fire Ranges)

Aircraft	Speed (knots)	Firing lane (meters)	Weapons	Distance X (meters)		Width of areas A and B (buffer zone) (meters)	Minimum safe engagement range (meters)
				Plan 1	Plan 2		
OH-6A, OH-58A	Below 100	400 x 1,600	7.62mm	4,200	3,100	200	100
UH-1	Below 100	400 x 1,600 (all weapons).	7.62mm.....	4,200	3,100	200	100
			40mm (M75 lchr).....	3,000	2,100	200	300
			2.75-inch FFAR.....	7,100	4,400	525	525
			Cal .50 machinegun.....	7,300	5,100	200	200
			M22 wireguided missiles	6,000	6,000	1,000	750
AH-1G	Above 100	1,000 x 3,000 (all weapons).	7.62mm.....	4,200	3,100	200	100
			20mm.....	6,400	4,600	300	300
			30mm.....	4,700	3,300	300	300
			40mm (M129 lchr).....	3,000	2,100	200	300
			2.75-inch FFAR.....	7,100	4,400	525	525



A. AH-1G (WITH TURRET STOPS SET AT 60°), OH-6A, OH-58A, AND UH-1B/C/M.

Figure 13-1. Recommended ranges for aviator firing exercises.



B. AH-1G TURRET FIRING WITHOUT STOPS.

Figure 13-1—Continued.

training targets and add a degree of realism. They should be placed in normal combat formations at various ranges.

(3) *Cloth panels.* Because they are very rap-

idly destroyed by rocket fire, cloth panels are the least desirable type of targets. They are 10- by 10-foot numbered or colored targets placed on 2- by 4-inch wood frames.

Section II. RANGE SAFETY

13-3. General

Aerial gunnery training uses live ammunition to provide a realistic training situation. However, this live firing does not preclude the application of safety procedures in the training environment. Each unit should develop range firing and safety standing operating procedures applicable to their special situation. For safety control plan requirements, see paragraphs 13-7 and 13-17. Range safety includes flight safety, firing safety, and ground safety. For helicopter aerial gunnery safety regulations, see AR 385-63. General safety rules are—

a. Whenever possible, armament subsystems will be pointed downrange or away from all populated areas during all range operations.

b. Armament subsystems are considered safe for range traffic pattern operations under "switches off" conditions. Refer to the appropriate technical manual for correct safing procedures for the weapons system.

c. Armament subsystems will go "switches hot" only if *all* of the following conditions are satisfied:

(1) Helicopter is on or past the start-firing line and is pointed downrange in the firing lane.

(2) No other aircraft are downrange in the range danger zone. (Helicopters maintaining lateral positions to each other may be cleared by control tower to conduct formation firing and team training.)

(3) Clearance is received from control tower to go "switches hot."

d. The operation and position of the arming switch is the responsibility of the instructor pilot or designated safety observer.

e. The instructor pilot or designated safety observer is responsible for all required radio calls pertaining to range operations.

f. Whenever possible and except when firing downrange or for practice runs within the maneuvering areas, helicopter will be flown at an altitude and over terrain where a forced landing could be safely completed.

13-4. Flight Safety

During the conduct of live fire training, it is especially important that all helicopters be operated in a safe manner. Too often, to the detriment of all, bad habits acquired in training are carried over to

actual operations. Anyone observing an unsafe act is responsible to report it to the OIC for corrective action. Flight safety also includes making the proper radio communications at the proper time.

13-5. Firing Safety

General safety requirements for firing machine-guns are contained in AR 385-63. For safety requirements for each subsystem, see the applicable 9-series and 55-series-10 TM (app A). In addition to the inspection of individual weapons, firing safety includes insuring that—

a. Clearance is received from the controller.

b. The weapon is on or past the SFL.

c. Weapons are pointed downrange and within the range fan limits.

d. If on the ground, no one is in front of the weapons.

e. No other aircraft are within the surface danger area.

f. The weapons are not fired at less than the minimum safe slant range.

g. Prior to leaving the range, a visual safety inspection is made of each weapon.

13-6. Ground Safety

Ground support personnel must constantly be made aware of the dangers involved in live fire training. Support personnel should be trained in the care and handling of ammunition, loading and unloading procedures for each weapons subsystem, and procedures for working near operating helicopters. Reloading areas should be separated from refueling areas. In addition, support personnel should be drilled in their duties for emergency situations.

13-7. Minimum Requirements for a Safety Control Plan

The minimum requirements for a safety control plan (para 13-17) are—

a. Each installation will have a readily available written set of range safety regulations.

b. An instructor pilot is present in aircraft when gunnery firing is conducted. The flight leader is responsible for assuring that the instructor pilot is qualified for the position and the particular training situation.

c. The instructor pilot will directly supervise all firing in conjunction with clearances obtained from the range control officer.

d. The instructor pilot is familiar with the impact area, firing limits, danger zones, and safety regulations of each firing range.

e. The instructor pilot is responsible for assuring that the firing is conducted only when aircraft is on course and weapons are aimed at target.

f. The instructor pilot is responsible for arming

and disarming the firing system. When firing is conducted which could result in impacts outside the target area or limits of fire, the instructor pilot will disarm the firing circuit.

13-8. Recommended Safety Control Plan

For recommended helicopter range firing and safety standing operating procedures, see paragraphs 13-9 through 13-29. Commanders and staff officers of each unit should develop range firing and safety SOP applicable to their special situation.

Section III. RECOMMENDED HELICOPTER RANGE FIRING AND SAFETY STANDING OPERATING PROCEDURES

13-9. Purpose and Scope

This section establishes range procedures and safety criteria for firing live ammunition from helicopter armament subsystems for training. It provides checklists, safety procedures, and range operating procedures for conducting helicopter range firing. For recommended door gunner range firing and safety standing operating procedures, see chapter 14.

13-10. References

- a. AR 385-63.
- b. Local range safety regulations.
- c. Local lesson plans for each armament subsystem.
- d. Technical manuals (app A). (For details of safety procedures in loading and unloading ammunition, see applicable 9-series and 55-series-10 TM.)

13-11. Definitions

a. Types of Fire.

(1) *Banking fire.* Firing performed while the helicopter is in a banking or turning maneuver.

(2) *Deflection fire.* The gunbore line and helicopter centerline are *not* parallel.

(3) *Diving fire.* Fire delivered from a helicopter while descending in altitude toward the target. The angle of attack is constant in relation to the centerline of the helicopter.

(4) *Diving to running fire.* A combination of diving fire and running fire.

(5) *Hovering fire.* Fire delivered from a helicopter at a stabilized altitude with zero ground-speed (hover).

(6) *Hovering/slow flight fire.* Fire delivered

with the attack helicopter in a concealed position. Available concealment must be used during the approach and execution of the fire mission. Where terrain permits, the helicopter should be moved laterally between bursts of fire so that it does not appear to the enemy twice in the same position.

(7) *Running fire.* Fire delivered while helicopter is in level flight at any altitude. A relatively constant airspeed and altitude are maintained.

b. Armament Subsystem Terms.

(1) *Fixed or stowed weapons subsystem.* A subsystem that is aimed at a target by the pilot aligning the helicopter in heading and attitude with the target. A *fixed subsystem* does not have the capability of independent movement in relation to the helicopter. A *stowed subsystem* is the emergency or standby status of a flexible weapon subsystem.

(2) *Flexible weapons subsystem.* A subsystem that is aimed at a target (within design limits) independently of helicopter heading or attitude.

(3) *Immediate action.* The procedure applied to reduce any stoppage without attempting to determine its cause.

(4) *Loaded subsystem.* Weapons subsystem condition when *any* ammunition is in the assembled subsystem and no positive physical action (e.g., gun barrels removed or firing circuit disconnected) is taken to prevent firing.

(5) *Malfunction.* Any failure (stoppage) of the subsystem that cannot be remedied while in flight (e.g., partial ignition of missile and runway gun).

(6) *Safety bridle.* Any physical device to prevent a flexible weapons subsystem from moving past a desired deflection or elevation limit in the event of a subsystem malfunction.

(7) *Subsystem secured.* All ammunition removed from the assembled subsystem, or components disassembled to positively prevent weapon loading.

(8) *Stoppage.* The failure to fire due to an interruption in the cycle of operation (functioning) caused by the faulty action of a weapon or faulty ammunition.

(9) *Switches cold.* Weapon subsystem loaded, arming switch in either the OFF or SAFE position, and no functioning possible.

(10) *Switches hot.* Weapon subsystem loaded, arming switch in the ARMED position, and all components energized and ready for firing.

13-12. Responsibilities

A live fire range may not be operated without the range control officer being present. Personnel involved in attack helicopter range operation must maintain continuous surveillance over all aspects of range operation and report unsafe conditions to the officer in charge or to the range control officer. The proper loading, boresighting, stoppage clearance, and range firing procedures and safety precautions prescribed herein and contained in applicable references must be followed. Training is to be conducted as prescribed in the local lesson plan, insuring that all live ammunition is cleared from the helicopter at the end of the firing period.

a. Officer in Charge (OIC).

(1) Senior officer of participating unit using range.

(2) Responsible for overall supervision of range personnel, activities, firing, and safety.

b. *Range Control Officer (RCO)/Safety Officer.* A qualified warrant or commissioned officer assigned the responsibility for the safe operation of assigned aircraft and weapon system. He must—

(1) Insure safe operation of the range.

(2) Be thoroughly familiar with range SOP and aircraft and armament emergency (preaccident) plan (para 13-14).

c. *Instructor Pilot.* The instructor pilot is a qualified warrant or commissioned officer appointed on competent orders who must—

(1) Be thoroughly familiar with the unit range SOP, aircraft and armament emergency (preaccident) plan (para 13-14), and local accident report form.

(2) Insure operation of assigned helicopter and weapons subsystem in accordance with prescribed procedures and applicable safety precautions.

(3) Be qualified in weapons subsystems.

(4) Be on board helicopter when training new individuals.

(5) Be familiar with the azimuth of range and sector azimuth limits.

(6) Direct arming and de-arming of weapons subsystem; de-arm subsystem when shooting results in impacts outside impact area.

(7) Insure conduct of training as prescribed in local lesson plan.

d. *Radio Operator/Controller.* The radio operator/controller must—

(1) Insure that radios are working properly.

(2) Open range upon order of RCO.

(3) Be thoroughly familiar with range SOP and aircraft and armament emergency (preaccident) plan (para 13-14).

(4) Assist RCO as directed.

e. *Senior Armorer.* The senior armorer must insure—

(1) The control and proper use of enlisted personnel on the ground.

(2) That proper equipment and required personnel are at the range to conduct firing and give necessary ground support.

(3) That the proper amount and type of ammunition are on hand for range firing.

f. *Noncommissioned Officer in Charge (NCOIC) of Ammunition Detail.* The ammunition detail NCOIC must—

(1) Brief detail on—

(a) Safe handling of ammunition.

(b) Loading procedures.

(c) Safety measures for ammunition and helicopter.

(d) Vehicle and helicopter parking areas.

(2) Supervise detail at all times.

(3) Police area during and after firing.

(4) Control loose rounds. (Inspect personnel prior to releasing them.)

13-13. Checklists

a. Officer in Charge.

(1) Prior to firing—

(a) Obtain present and forecasted weather for the period of firing.

(b) Obtain helicopter tail numbers and assign them to instructor pilots.

(c) File flightplan for period of firing.

(d) Verify that required armament personnel and equipment are present.

(e) Verify ammunition loading by type and amount with senior armorer.

(f) Brief range control officer.

(g) Conduct gunner/pilot safety and range briefing as specified in local lesson plan.

(h) Prescribe helicopter formation for flight to the range.

(i) Monitor helicopter maintenance difficulties and coordinate any required maintenance.

(2) During firing—

(a) Supervise flight operations and safety procedures.

(b) Periodically observe and spot check ground operations.

(3) After firing—

(a) Verify completion of range closure and reports as required by the current range regulations.

(b) Debrief gunner/pilots as specified in local lesson plan.

(c) Report helicopter deficiencies, number of stoppages, and time lost as required.

(d) Supervise completion of reports and flight folders as prescribed by local range regulations.

b. Range Control Officer.

(1) *Prior to opening range for firing—*

(a) Obtain a range briefing from the post range officer as required by current local range regulations.

(b) Inspect firing line area, parking areas, ammunition loading areas, and area of range visible from control tower for safety hazards and proper positioning of vehicles, helicopters, and equipment.

(c) Brief crash-rescue team and—

1. Determine any firefighting vehicle or equipment deficiencies.

2. Determine if equipment has been fully checked out.

3. Check qualifications of emergency crew (minimum of two must be qualified crewmen).

4. Brief crew leader on—

(a) Desired standby location to insure immediate availability to control tower or vehicles.

(b) Helicopter range, orbit operating areas, and specific range activities for firing to be conducted each day.

(c) Knowledge of access routes to helicopter operating areas.

(d) Notification and dispatch of emergency crew (will only be by RCO or radio operator/controller).

(e) Methods of emergency clearing of armament subsystem in crash-rescue operations.

(f) General crash/emergency procedures as prescribed in aircraft and armament emergency (preaccident) plan (para 13-14).

5. Brief ambulance driver on route to take to the hospital.

6. Check qualification of first aid man.

7. Determine deficiencies of ambulance vehicle or first aid equipment. The following equipment must be present:

(a) Two litters.

(b) One blanket set.

(c) One first aid kit.

(d) One splint set.

(e) One bottle of impregnated salt tablets (100).

(f) Two canteens filled with water.

(d) Brief senior armorer. Determine deficiencies of personnel and/or equipment. Prescribe vehicle parking area, and organization and operation of crew to service attack helicopters. Review the following safety precautions as required:

1. Approach attack helicopter from side only, staying clear of rotors and subsystems' flexible limits of movement.

2. Inspect each weapons subsystem for safety prior to loading for firing.

3. No smoking allowed within 50 feet of helicopters or ammunition.

4. Use available protective devices; i.e., ear plugs, dust goggles, etc.

5. Use containers for collection of ammunition and brass.

(e) Brief NCOIC of ammunition detail. Determine ammunition count and any equipment deficiencies. Check the organization and operation of the ammunition detail and review the following safety precautions as required:

1. Safe handling of ammunition.

2. Cleanliness of ammunition (freedom from sand, dirt, grease, etc.).

3. No smoking allowed within 50 feet of ammunition or helicopter.

4. Use of protective devices available; i.e., ear plugs, dust goggles, etc.

5. Control of loose rounds.

(f) Brief refueling personnel on helicopter refueling and vehicle parking areas and range safety.

(g) Contact range headquarters for clearance to fire; record name of person giving clearance and time.

(h) Before firing, insure that first aid man, ambulance, and ambulance driver are present;

range flag is up; and range sweep by helicopter is complete.

(2) *During firing—*

(a) Maintain positive radio control of all helicopters operating on the range.

(b) From control tower, observe all visible range activities for efficiency and safety.

(c) As helicopter control situation (proficiency of radio operator/controller) permits, report to official visitors and inspecting officers.

(d) Release POL vehicle when all scheduled refueling is completed.

(e) Maintain record by name of personnel aboard each helicopter.

(f) Maintain a record of the number of helicopter armament stoppages (by helicopter tail number and total time lost).

(3) *After firing—*

(a) Close range with range headquarters as required by range regulations and record time and name of person receiving report.

(b) Inspect range area to insure that—

1. Range flag has been lowered.

2. Building(s) and tower are secured.

3. Operating areas (firing line, tower, and parking areas) are policed.

4. Mutilated and live ammunition and expended brass are policed from firing line and placed in appropriate boxes for return to ammunition dump.

(c) Release armament detail.

(d) Notify crash-rescue team, ambulance, and civilian/military maintenance personnel that firing is completed. Depart only after last helicopter is airborne.

c. Instructor Pilot.

(1) Check for proper procedures and safety in loading, boresighting, test firing, and stoppage clearance by all personnel in the vicinity of the helicopter.

(2) Continually observe all aspects of range operation and report unsafe conditions to the OIC or RCO.

(3) Insure that firing is conducted only when—

(a) Helicopter is on course.

(b) All weapons are aimed at target.

(4) Insure that all live ammunition is cleared from the helicopter at the conclusion of the firing period.

d. Radio Operator/Controller.

(1) Put up range flag.

(2) Turn on range tower radios, and make sure they are working properly.

(3) Review range SOP.

(4) Open range upon order of RCO.

(5) Assist RCO in traffic control as per range SOP.

(6) Close range upon order of RCO.

(7) Turn off radios.

(8) Take down range flag.

e. Senior Armorer.

(1) *Prior to firing—*

(a) Check personnel and equipment.

(b) Obtain helicopter tail numbers and verify that ammunition loading is correct.

(c) Assign duties to crew (armorers to helicopter and driver to vehicle, etc.).

(d) Brief crew as follows:

1. Location of helicopter parking areas.

2. Location of vehicle parking areas.

3. Type of firing table, ammunition load, etc.

4. Review the following safety precautions as required:

(a) Approach and depart vicinity of helicopter from side only after visual recognition from instructor pilot in the helicopter.

(b) Last man to leave vicinity of helicopter will give "all clear" signal to instructor pilot.

(c) Remain to rear of loaded subsystem at all times.

(d) Secure subsystem before anyone enters or leaves the helicopter or as directed by instructor pilot.

(e) Remain clear of subsystem areas during boresighting, etc.

(f) Check subsystem only when arming switch is in "safe" position as directed in appropriate TM and unit SOP.

(g) Check proper installation of safety bridles.

(h) No smoking within 50 feet of ammunition or helicopter.

(i) Use available protective devices; i.e., ear protectors.

(j) Secure loose equipment in helicopter.

Caution: In case of emergency, stay at duty position until directed otherwise by officer or NCOIC.

(e) Visually inspect range area on and behind firing line for safety.

(2) *During firing* Supervise all armament crew activities for operation and safety.

(3) *After firing.*

(a) Police firing line for—

1. Live rounds in specified container for return to ammunition area.

2. Expended brass in specified container for turn in to ammunition area.

(b) Police range areas behind firing line (parking areas, in vicinity of tower, etc.).

(c) Check security of buildings and equipment on the range.

(d) Check security of buildings and equipment at classroom/briefing area.

f. NCOIC of Ammunition Detail.

(1) Brief detail as follows:

(a) Safe handling of ammunition.

(b) Loading procedures.

(c) Safety measures for ammunition and helicopter.

(d) Location of vehicle and helicopter parking areas.

(2) Supervise detail at all times.

(3) Police area during and after firing.

(4) Control loose rounds. (Inspect personnel prior to releasing them.)

13-14. Aircraft and Armament Emergency (Preaccident) Plan

a. Purpose. The aircraft and armament emergency (preaccident) plan prescribes the procedures to be followed in the event of an aircraft emergency (accident, incident, or inadvertent firing) during conduct of range firing.

b. RCO/Controller Checklist. Any emergency (*a* above) will be reported immediately by the RCO or any officer on the range as prescribed by local range regulations. The preaccident plan will be initiated upon receipt of this report.

(1) Report the following by radio or telephone:

(a) Location of accident.

(b) Time accident occurred.

(c) Type aircraft involved.

(d) Injuries to personnel, if any.

(e) Other pertinent facts available.

Note. Individuals involved in an accident will complete a report (on the local form provided) at the scene of the accident as soon as practical and turn it in to the unit safety officer.

(2) Dispatch ambulance and crash-rescue team to the site simultaneously with report ((1) above).

(3) Designate one helicopter to proceed to crash site to assist the ambulance and crash-rescue team and to establish radio communications at the crash site.

(4) Designate one helicopter to orbit crash

site at 1,500 feet absolute altitude and guide rescue helicopter to the area by radio.

(5) Direct remaining helicopters to firing line or loading area to await further instructions.

(6) Notify post range officer by telephone. Request that other ranges cease fire until further notice, depending on the location of the crash.

(7) As soon thereafter as possible, report by telephone to *one* of the following—in this order:

(a) Immediate supervisor.

(b) Commander.

(c) Operations officer.

13-15. Crash-Rescue Plan

The crash-rescue plan—

a. Provides for a minimum of two helicopters on range for live firing.

b. Provides for an ambulance, as required by regulations.

c. Recommends crash-rescue team for range.

d. Defines responsibilities of helicopter crew while in the air.

e. Defines responsibilities of officers and NCO while on the ground.

f. In order of priority, list names and telephone numbers of individuals to be notified in the event of a crash.

13-16. Malfunctions Involving Ammunition

a. Malfunctions include—

(1) Hangfires.

(2) Preignition.

(3) Duds.

b. In the event of such a malfunction—

(1) Attempt to jettison missiles in a safe area.

(2) Notify the range safety officer immediately of action taken or failure of missiles to jettison. If missiles fail to jettison, land helicopter as directed by the range safety officer at a location which will assure safety of personnel and facilities. Evacuate helicopter and await assistance.

(3) Explosive ordnance disposal personnel, if available on the range to support range firing, will render any assistance necessary to eliminate explosive hazards and make the situation safe.

(4) The range safety officer will immediately notify the post ammunition officer of the type, location, and nature of the ammunition malfunction. The ammunition officer will obtain the assistance of explosive ordnance disposal personnel,

unless such personnel have been provided to support range operations, and will investigate malfunctions.

13-17. Safety Control Plan

A diagram will be made outlining each range. This diagram will show the location of range facilities, any appropriate range fan information, and flight routes to and from the firing lane. For minimum requirements for safety control plan, see paragraph 13-7. Examples of specific safety instructions include—

a. Minimum altitudes to be flown over adjacent areas.

b. Other range impact areas to be avoided.

c. Hazards to flight during low altitude runs on targets; e.g., high trees at the end of the firing lane. Pullups must be initiated in sufficient time to clear all obstacles.

d. Possible cautions for—

(1) Conducting nap-of-the-earth operations in the early morning or late afternoon if the range is oriented into the sun.

(2) Other aircraft operating in the vicinity.

(3) Operation in vicinity of a highway.

13-18. Range Facilities

Range flag(s), road guards, and range markers are as prescribed by local range regulations. Range facilities include the following:

a. Control Tower. A control tower should be located on each firing range. Each tower is equipped with radios, telephones, and an emergency warning device. If a control tower is not available, a 1/4-ton vehicle with radio positioned to enable the controller to observe firing lanes and targets may be used.

b. Markers.

(1) *Start-fire line.* The start-fire line on each range may consist of an asphalt or concrete pad, with parking spots marked for each helicopter. Approaches to and from the start-fire line will be kept clear of all vehicles, obstructions, and loose objects likely to interfere with helicopter operations.

(2) *Cease-fire line.*

(3) *No-fly line.*

c. Helicopter Parking Areas. When available, helicopter parking areas are located adjacent to the start-fire line and are used by all helicopters not actively engaged in training. Parking areas

may be located on or near the start-fire line (b(1) above). Helicopter landing areas should be protected from dust to prevent visibility hazards and damage to helicopter components.

d. Vehicle Parking Areas. When space is available, separate vehicle parking areas are located clear of all aircraft operations. If separate parking areas are not available, parking areas will be located near the control tower on the opposite side from the firing line. Whenever possible, military vehicles will be unloaded and parked in designated areas away from aircraft operations. Civilian vehicles will be parked in designated areas completely clear of all aircraft and military vehicle operations.

e. Ammunition Areas. When applicable, ammunition areas are located in an area separate from other activities and adjacent to the helicopter parking area. Whenever possible, ammunition preparation and loading activities should be shielded from blowing dust and dirt.

f. Communications.

(1) Two-way radio communications will be established and maintained with all helicopters operating on the range.

(2) Telephone communications with range headquarters will be established and maintained at all times while the range is in operation. In an emergency, radio communication to another range tower that has telephone communication is acceptable until emergency repairs are completed.

13-19. Air Safety

a. Weather.

(1) Minimum visibility for range firing is 1 nautical mile.

(2) Minimum ceiling for range firing is clear of clouds.

(3) Wind limitations depend on—

(a) Local flying regulations.

(b) Aircraft flight limitations.

(c) Judgment of the range officer in charge.

b. Helicopters.

(1) Operational helicopters must have a minimum of one radio for two-way communication with the control tower.

(2) Helicopters will not be operated with any unsecured equipment in the pilot and/or cargo compartment.

(3) Passengers or observers will not be carried in helicopters operating on the range unless

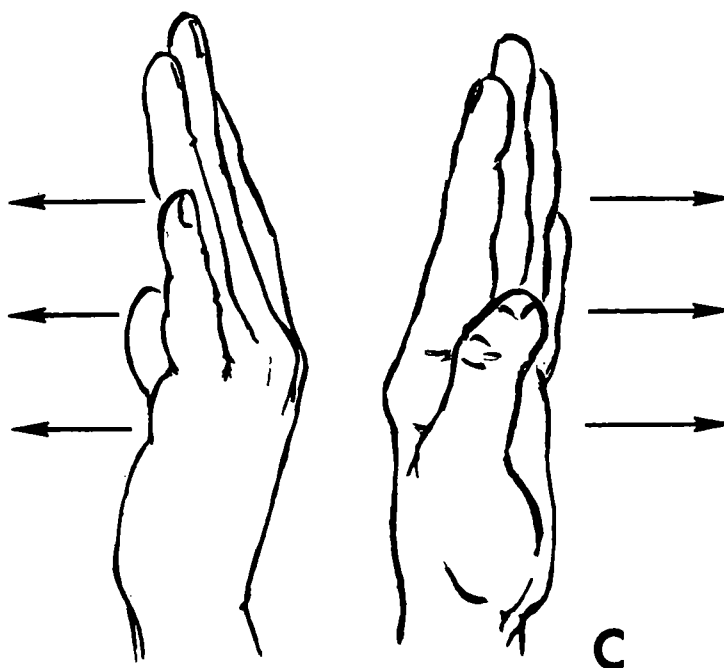
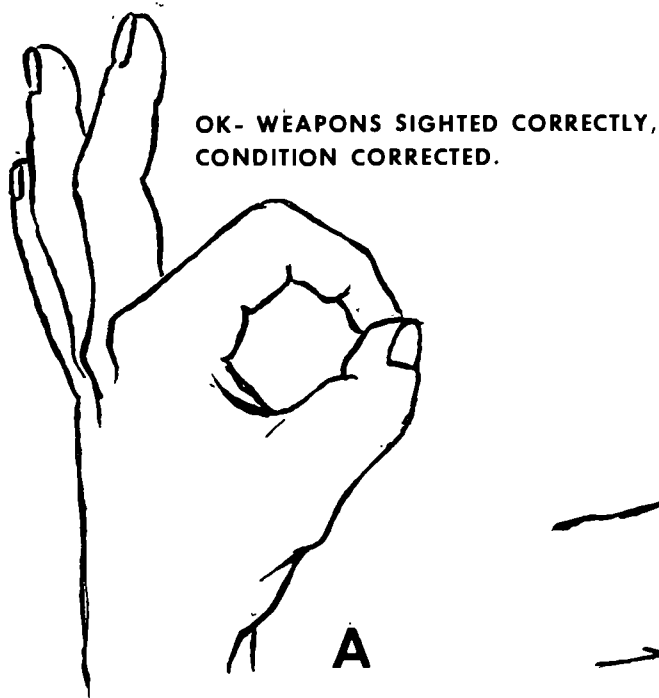
individually approved by the range officer in charge.

(4) Armament subsystem must be "secured" en route to and from the firing range.

c. Routes. Low-level training flights will be restricted to previously reconnoitered routes. All

hazards to low-level flight, especially wire hazards, will be appropriately marked on an up-to-date map overlay. Overlays will show flight routes to and from ranges, specified flight altitudes, and hours between which these flights may take place.

Caution: Helicopters with loaded weapons should not overfly inhabited areas.



AZIMUTH ADJUSTMENT- HAND UP, PALM TOWARD DIRECTION ADJUSTMENT DESIRED. MAGNITUDE OF MOVEMENT INDICATES RELATIVE AMOUNT OF ADJUSTMENT REQUIRED.

Figure 13-2. Hand signals for pilots, gunners, and armorers.

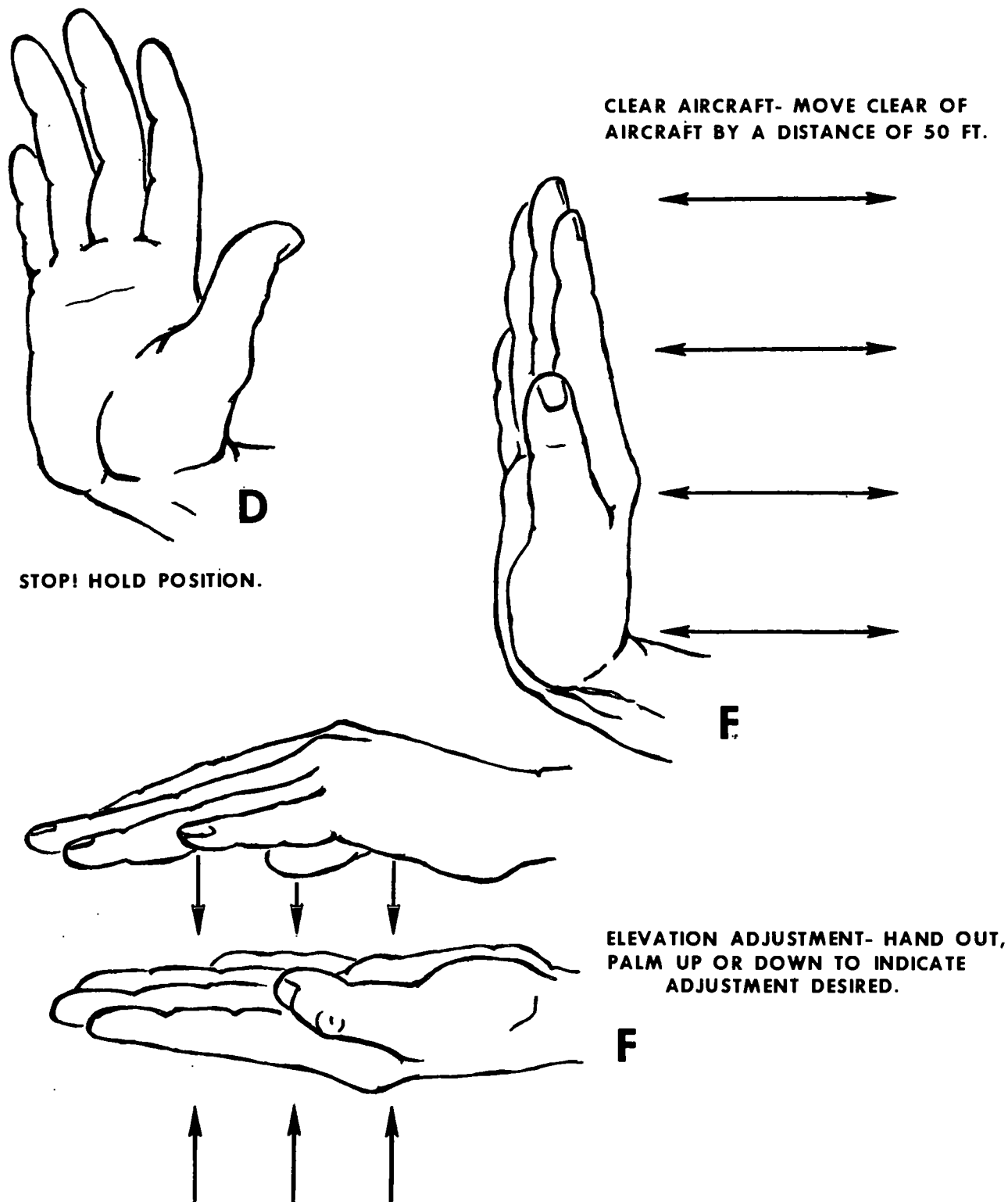


Figure 13-2—Continued.

(1) *En route procedures.*

(a) To provide additional aviator training in formation flying, helicopters will fly in formation whenever practical. Minimum distance between helicopters is 1½-rotor diameters.

(b) Minimum en route altitude away from populated areas is 100 feet absolute altitude;

nap-of-the-earth techniques (altitudes) will apply for range operation.

(c) Formation landings and takeoffs are authorized.

(2) *Return from the ranges and helicopter shutdown.*

(a) Prior to departure of helicopters for home station, subsystems will be secured and deactivated at the range.

(b) Following helicopter shutdown, all ammunition will be removed from the helicopter.

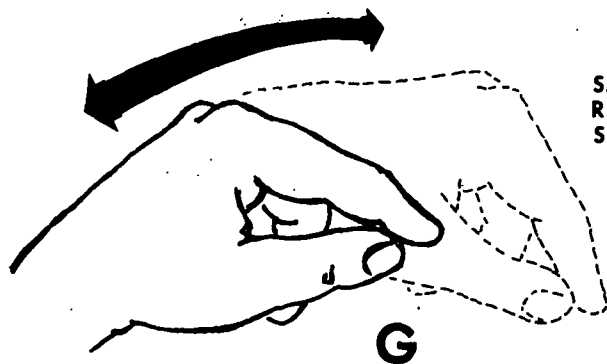
13-20. Ground Safety

a. All personnel (including helicopter crews) will avoid passing in front of loaded armament subsystems.

b. Personnel will approach the helicopter from the 90° side position and only after receiving visual recognition from the instructor in the helicopter.

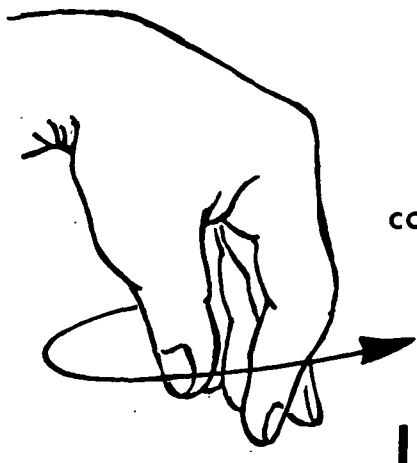
c. All personnel will exercise extreme caution while walking under the main rotor arc or in the vicinity of the tail rotor.

d. Helicopter will not be moved until an armor-



SAFE-ARM. SIMULATED MOVEMENT OF SWITCH TO REAR-PLACE SWITCH SAFE. SIMULATED MOVEMENT OF SWITCH FORWARD INDICATES PLACE SWITCH ARMED.

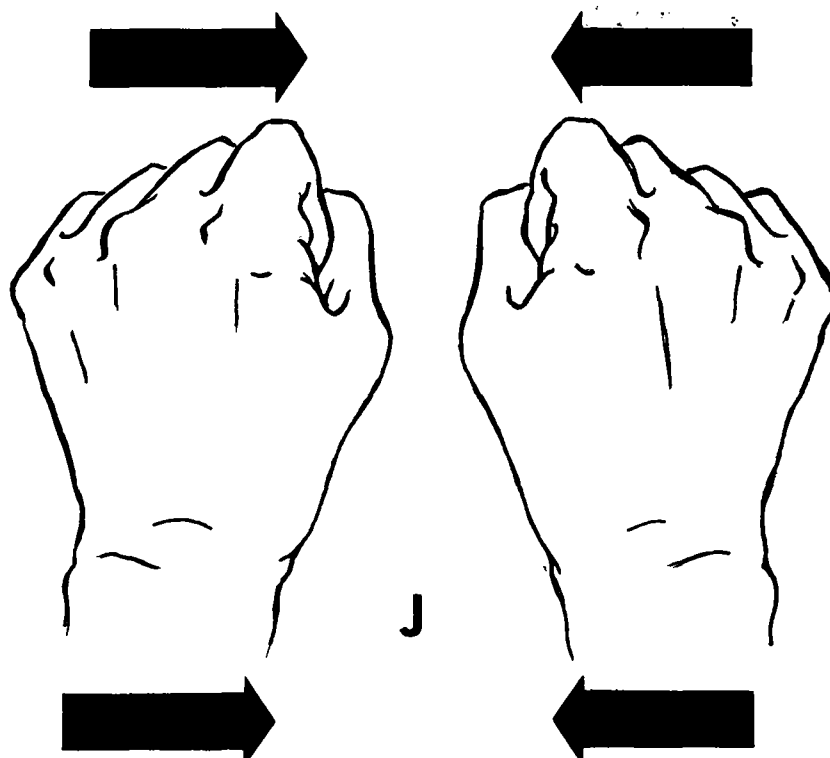
STOPPAGE OF BOTH GUNS-
POINT TO SIDE ON WHICH STOPPAGE OCCURS.



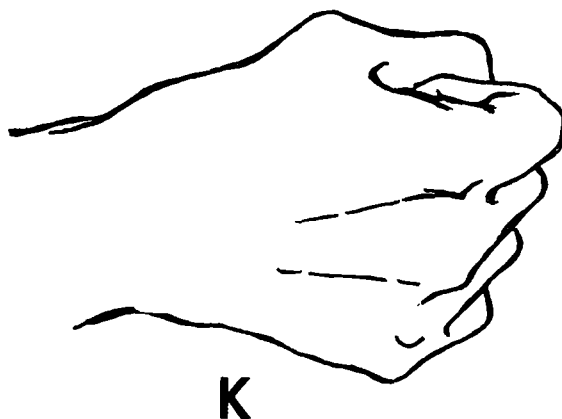
CONNECT CANNON PLUG ON ROCKET LAUNCHER-
POINT TO SIDE TO BE CONNECTED.

Figure 13-2—Continued.

MOVE HANDS TOGETHER. ARM SYSTEM (LOAD AMMUNITION).



MOVE HANDS APART. DISARM SYSTEM (UNLOAD AMMUNITION).



DEPRESS ACTION SWITCH.

Figure 13-2—Continued.

er moves out of the main rotor arc at the 90° side position and signals "all clear."

e. Hand signals are necessary to maintain communication between the pilot, gunner, and armorers servicing the armament subsystems mounted on the helicopter. The standard signals given in figure 13-2 facilitate range operations, clearing of

stoppages, and loading. During night operations, the cockpit light, a flashlight, or other hand-held lighting device is used to make the appropriate hand signals visible. During night operations, care must be taken to conserve night vision.

f. Only authorized personnel who have received training in range operating and safety procedures will perform armorer duties.

Section IV. RANGE OPERATION

13-21. Range Preparation

a. Range Clearance. Range area should be cleared by an aerial reconnaissance of the range before firing, or clearance obtained as specified by local regulations.

b. Landing on Firing Line. Helicopters will land on marked pads on the firing line with armament subsystems pointed downrange in the firing lane.

c. Range Control. Communications will be maintained at all times between aircraft and control tower. Firing will be suspended immediately upon loss of communication.

(1) Upon completion of loading, boresighting, harmonization, and test firing (as appropriate), the instructor pilot will declare "switches cold" and request to initiate a firing exercise, takeoff to maneuvering area, etc. All helicopter movement will be on or behind the firing line unless specifically approved for downrange operations.

(2) All clearances from the control tower will include the specific action that is approved. For example, "Seven three cleared hot, test fire;" or "Seven three cleared left, break to attack position."

(3) When appropriate, any helicopter pilot not reporting "switches cold" will be challenged immediately by control tower—"Check switches cold."

13-22. Loading and Unloading

a. The entire flight pattern from the ammunition loading site to firing lane, return to firing lane, and return to loading site will be established by a plot or map. The course will be so selected that any accidental firing at any point on the course will not result in hazard to life or property. In addition, an emergency holding course will be designated. In the event of misfire, malfunction, possible cookoff, or emergency conditions, the pilot will automatically proceed to the area until steps can be taken to provide for the emergency, or the pilot is authorized by the officer in charge of the installation to land under emergency conditions.

b. The weapon should be safed before any attempt to inspect/remove ammunition. See caution in pertinent TM. For example, for 7.26mm multi-barrel weapon, install bullet trap assembly, remove safing sector, etc.

c. On 7.62mm multibarrel weapon, bullet trap

assembly should be installed and safing sector removed prior to any attempt to unarm or remove ammunition.

d. Prior to loading and unloading rockets, ground the helicopter, disconnect the helicopter battery and external power source, and have qualified personnel check for stray voltage. Turn off all radio transmitters. After rockets are loaded on board, no mobile or portable radio communications equipment will be permitted to transmit within 16 meters of the loaded helicopter.

13-23. Arming Firing Circuits

Weapon systems firing circuits will not be armed until helicopter is on course and just prior to reaching the start-firing line. All firing circuits will be disarmed when helicopter reaches cease-fire line or when flying in an emergency holding area.

13-24. Caution in Firing Rockets

Air density, propellant burning time, and environmental winds affect rocket trajectory. The rocket is sensitive to environmental wind conditions and changes in range and deflection can occur under moderate to severe conditions. Troop safety in connection with firing rockets must be especially scrutinized to assure no possibility of hazard exists.

13-25. Target Engagement

a. Switches. Switches may not be placed in the ARMED position until the helicopter is at or past the start-fire line and must be placed in the SAFE position upon reaching the cease-fire line.

b. Impacts. All rounds must impact within the firing lane or impact area.

c. Targets. Targets beyond the cease-fire line may be engaged, but all fire must cease at the cease-fire line.

d. Deflection. It is permissible to engage targets at deflection angles up to 20° either side of the range centerline. There is provision for AH-1G firing of turrets to exceed these limits. The UH-1B/C/M helicopter must be flown at a 90° angle to the centerline to fire deflection shots at angles greater than 20°. For example, to fire a deflection shot of 110° to 70°, the helicopter must be flown perpendicular to the range centerline (fig 13-3).

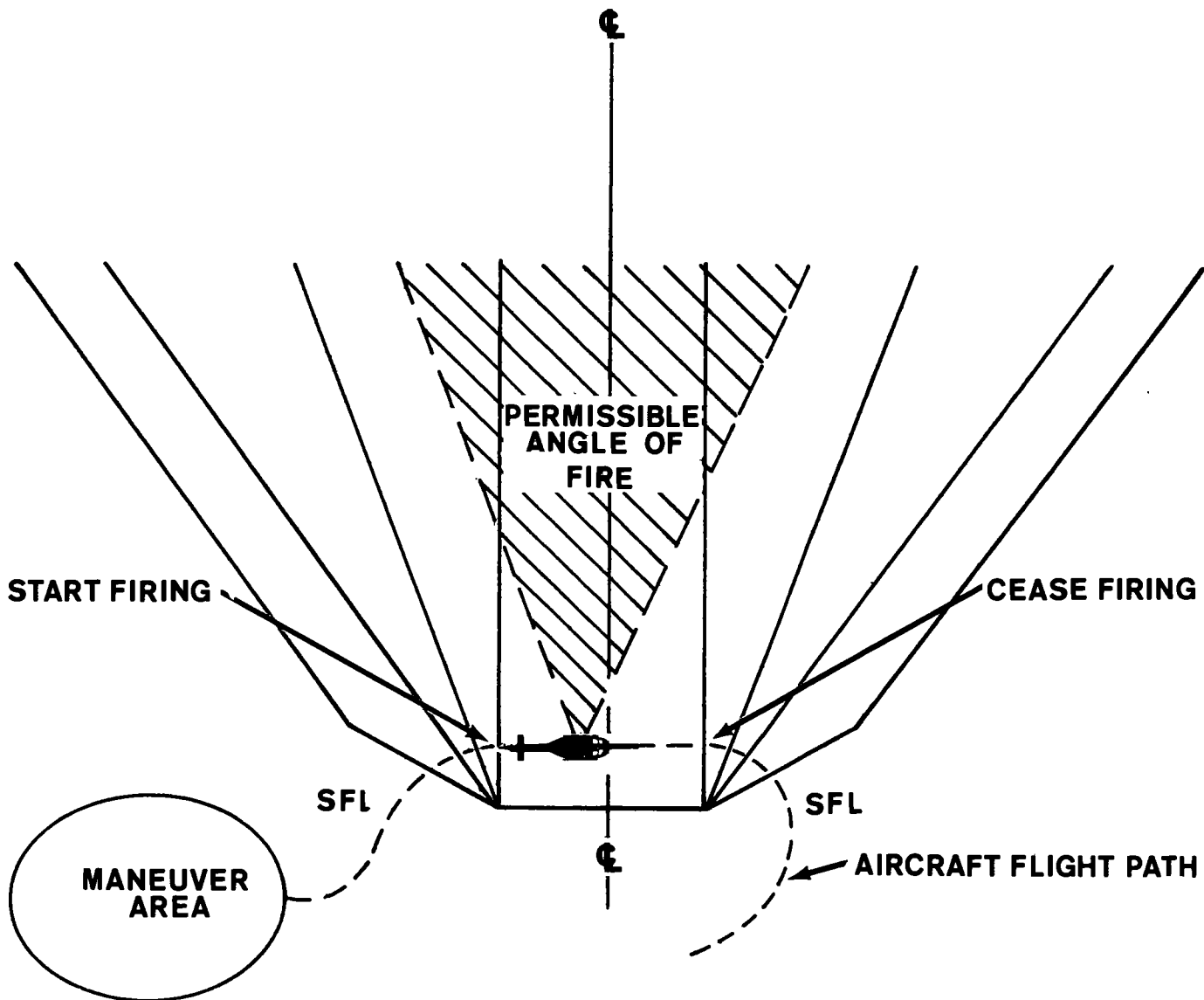


Figure 13-3. Permissible angle of fire for deflection shots in excess of 20°.

13-26. Instruction Techniques

a. Because of the type of armament subsystem and the coordination involved in operating as a pilot/gunner team, both aviators should be trained together.

b. The instructor will critique the aviators on each flight.

c. To insure that safety limits are not exceeded, the instructor should always have his hands within easy reach of the OFF-SAFE-ARMED switch.

13-27. Senior Armorer

The senior armorer is the NCOIC of the armorer detail and supervises weapons maintenance, load-

ing, unloading, harmonization, and boresighting. In addition, he is responsible for policing the firing line.

13-28. Conduct of Training

a. *Prior to Firing.* Prior to the beginning of live firing on the range—

- (1) Range guards must be posted.
- (2) Crash/rescue team and ambulance must be in position.
- (3) Medical evacuation helicopter must be available.
- (4) Control element must be in operation.
- (5) Range flag must be flying.
- (6) Range must be checked to insure that no personnel are in the surface danger area.

(7) Permission must be received from the range officer to commence firing.

b. During Firing. All safety restrictions must be met during firing; otherwise, the OIC or the RCO is required to stop training until they are corrected. To properly control traffic, the following radio communications are mandatory:

(1) Communications must be maintained between all aircraft and the tower at all times.

(2) Permission must be received from the controller for all takeoffs and landings.

(3) Permission must be received from the controller before placing any switch in the "hot" (ARMED) position.

(4) Controller must be notified when systems are "cold" (SAFE).

(5) Controller must be notified when "clear" of the surface danger area.

c. After Firing. Upon completion of training, all aircraft will be cleared and unarmed before leaving the range. The range officer should be notified of the conclusion of training, the amount and type of ammunition expended, and the location of any known duds. In addition, the area should be cleared of all debris and loose brass.

13-29. Layout of the Aerial Fire Range

a. Terrain. When practical, the firing lane should be laid out on relatively open terrain to facilitate emergency landings. In addition, it is desirable for the CFL markers to be visible from the tower. To facilitate harmonization of weapons

systems, the first 500 meters of the firing lane should be clear and on relatively flat terrain. When possible, terrain other than the firing lane should be left in the natural state to add realism to the training.

b. Markings. The SFL and the CFL must be clearly marked and visible from the air. For control purposes, it is also desirable that they be visible from the tower. Landing pads on the firing line should be clearly marked for both day and night landings.

c. Targets. The nature and arrangement of targets should be varied to provide the widest latitude in training. To facilitate harmonizing, one target should be placed at the harmonization distance for each weapon system.

d. Tower. When practical, the tower should be a permanent structure incorporating electrical power for heating, lighting, and radios, and direct land-line communications to range headquarters and the crash/rescue telephone net. For safety, the tower should be erected on the same side of the firing lane as the traffic pattern.

e. Ammunition Area. An area for the assembly and storage of ammunition should be established away from the tower and firing line. This area should be well-drained, bunkered, and away from aircraft flightpaths.

f. Interlocking Range Fans. With proper spacing of firing lanes and adjustment of traffic patterns, it is possible to use a common impact area for several aerial fire ranges.

Section V. RANGE SCORING

13-30. Scoring Methods

All initial and annual qualification firing must be scored. Familiarization training normally does not require targets to be scored. Scoring may be accomplished by—

a. Visual Means. Visual scoring may be accomplished by the hit-count method. This method requires an observer to make an actual count of the number of rounds that hit the target. To count the number of hits, four different methods may be used:

(1) An official scorer may fly in an aircraft above the range and score each firing pass.

(2) Two observation posts may be established in towers: one tower is located on each side of the start-fire line. Each observer determines the azimuth from his position to the impact and,

by using intersection lines, triangulates the point of impact. While this method is very accurate, it requires well-trained observers and is time consuming.

(3) When applicable, the helicopter instructor pilot records the number of hits during each firing pass.

(4) A scorer records hits from a 1/4-ton radio-equipped vehicle positioned to observe firing lanes and targets. This method is suitable for flat terrain without vegetation.

b. Electronic Means. Acoustic or other electronic scoring devices may be used. However, when HE ordnance is used, these sensing devices are destroyed. More durable range scoring devices are now under development and should be available in the near future.

13-31. Scoring Criteria

Scoring criteria will be determined by the commander. For example, a recommended method of scoring is—

- a. Within 10 meters ----- A.
- b. Within 20 meters ----- B.
- c. Within 30 meters ----- C.
- d. Beyond 30 meters ----- U.

Section VI. AMMUNITION REQUIREMENTS FOR AERIAL GUNNERY**13-32. General**

The type of training to be given to the individual flight crewmember depends upon the state of proficiency required for him to accomplish his mission. Any crewmember must meet certain prerequisites prior to receiving weapons training. For example, pilot gunners must first be qualified to pilot the helicopter.

13-33. Familiarization Firing

Familiarization firing is authorized by the unit commander for individual flight crewmembers, as required. Sufficient firing is required to gain a basic working knowledge of the capabilities and limitations of the weapon subsystem. However, it is not necessary to attain a stated level of proficiency.

13-34. Initial Qualification Firing

Initial qualification firing provides sufficient gunnery training for the individual to attain a satisfactory level of proficiency for firing each armament subsystem.

13-35. Annual Qualification Firing

Annual qualification firing is given to maintain the aviator's proficiency at a specified level for firing the armament subsystem assigned to his

unit. For recommended firing tables for annual qualification firing, see section X.

13-36. Authorized Ammunition Allowances

Authorized ammunition allowances for aerial gunnery training are contained in CTA 23-100-6. Commanders must insure that ammunition expended will not exceed authorized allowances. Tables 13-2 through 13-4 are provided for guidance purposes only and do not restrict flexibility exercised by local commanders. Qualification on the M22 armament subsystem is conducted only at the US Army Aviation School. The ammunition requirements for annual proficiency firing of the M22 armament subsystem are given below.

Armament subsystem	Helicopter	Wire-guided missile ammunition (No. rounds per individual)	
		ATM-22B w/inert warhead	AGM/22B w/HEAT warhead
M22 -----	UH-1B/C/M	5	1

13-37. 7.62mm, 20mm, and 30mm Ammunition Requirements

For 7.62mm, 20mm, and 30mm ammunition required for aerial gunnery training with OH-6A, OH-58A, UH-1B/C/M, and AH-1G helicopter armament subsystems, see table 13-2.

Table 13-2. 7.62mm, 20mm, and 30mm Ammunition Requirements for Aerial Gunnery

Armament subsystem	Helicopter	Automatic gun	Ammunition (No. of rounds per individual)		
			Initial qualification	Annual qualification	Familiarization
			Ctg ball, 7.62mm, TR 4-1, MLB	Ctg ball, 7.62mm, TR 4-1, MLB	Ctg ball, 7.62mm, TR 4-1, MLB
M21	UH-1B/C/M	M134	10,000	26,500	2,000
M27E1	OH-6A OH-58A	M134	7,000	4,000	1,500
M28A1	AH-1G	M134	4,000	14,600	1,500
M18A1 (Pod)	AH-1G	M134	6,000	4,500	3,000
			Ctg 20mm Linked 4TP to 1TP-T	Ctg 20mm Linked 4TP to 1TP-T	Ctg 20mm Linked 4TP to 1TP-T
M35	AH-1G	XM195	250	780	475
			Ctg, 30mm, HE, PD	Ctg, 30mm, HE, PD	Ctg, 30mm, HE, PD
XM120	AH-1G	XM140	300	150	150

13-38. 2.75 Inch FFAR Ammunition Requirements

For 2.75-in. FFAR ammunition requirements for UH-1B/C/M and AH-1G armament subsystems, see table 13-3.

13-39. 40mm Ammunition Requirements

For 40mm ammunition requirements for UH-1B/C/M and AH-1G helicopter armament subsystems, see table 13-4.

Section VII. OBSERVATION HELICOPTER GUNNERY INITIAL QUALIFICATION RANGE FIRING

13-40. General

This section is a guide for unit commanders to initially qualify aviators in the observation helicopter armament subsystems. Local modification of the methods and techniques used here may be made at the discretion of the unit commander.

13-41. Subsystems Qualification

To qualify in the light observation helicopter armament subsystems, an aviator should thoroughly understand weapons operation and the tactical use of the aircraft-weapons system. The following items are recommended for training an aviator in observation helicopter armament subsystems. For information on these items, see the index and appendix A.

a. Gunnery Proficiency.

- (1) Loading, preflight, and cockpit procedures for day and night firing.
- (2) Boresight procedures and hand signals to ground crews (fig 13-2).
- (3) Burst control.
- (4) Ammunition management.
- (5) Gunnery flight techniques for diving, running, and nap-of-the-earth firing runs.
- (6) Armament subsystem introduction—assembly, disassembly, and troubleshooting.
- (7) Range estimation.
- (8) Development of sight pictures.
- (9) Burst on target techniques.
- (10) Effects of airspeed, altitude, and angle of attack on the beaten zone.
- (11) Engagement and disengagement ranges.
- (12) In a nap-of-the-earth environment, problems of flying and firing in a steep dive and in transition from diving to running techniques.
- (13) Proper planning.
- (14) Yaw effect.
- (15) Target transition.
- (16) Engagement, disengagement, and evasive maneuvers.
- (17) Night firing techniques—

- (a) Range estimation.
- (b) Safety factors in night operations.
- (c) Techniques of using artillery or aircraft illumination.
- (d) How to conserve night vision.
- (e) Aircraft lighting techniques.

b. Tactical Proficiency.

- (1) Scout team tactics for air cavalry units.
- (2) Tactical formations.
- (3) Reconnaissance.
- (4) Low-level observation techniques.
- (5) Low- and high-level navigation.
- (6) Nap-of-the-earth flying.
- (7) Evasive flying techniques.
- (8) Safety hazards to low-level flight.
- (9) Map reading.
- (10) Tactical flight planning.
- (11) Reporting procedures.

13-42. Tactical Flight Training Period

Due to the complexity of the observation mission, several training missions should be planned and flown so that the aviator will become thoroughly familiar with his observation assignment.

13-43. Range Facilities

Prior to any live fire exercises, range facilities must be made available. For information on range facilities, see paragraph 13-18 and AR 385-63.

13-44. Range Firing Tables

The range firing tables (tables 13-5 through 13-7) are for M27E1 armament subsystem aerial gunnery initial qualification firing. Prior to firing any qualification tables, performance charts contained in appropriate aircraft operator's manuals (55-series-10) must be consulted to insure that table requirements are within allowable safe load limits for the conditions present.

- a. Period 1.* 1 hour and 30 minutes dual flight time (table 13-5).

Table 13-3. 2.75-In FFAR Ammunition Requirements for Aerial Gunnery

Armament subsystem	Helicopter	2.75-in. rocket launcher	Ammunition (No. of rounds per individual)				
			Initial qualification		Annual qualification	Familiarization	
			Rkt 2.75-in., practice	Rkt 2.75-in., HE	Rkt 2.75-in., HE	Rkt 2.75-in., practice	Rkt 2.75-in., HE
M21	UH-1B/C/M	M158A1/M200A1	56	74 Note 1	84 Note 2	12	8 Note 3
	AH-1G	M158A1/M200A1	18	47 Note 4	160 Note 5	7	8 Note 3

NOTES

1. Includes 2 rockets with 17-lb whd and proximity fuze, 2 with 10-lb whd and proximity fuze; 2 with flechette whd; balance with 10-lb whd and PD fuze.
2. Includes 14 rockets with 17-lb whd and PD fuze, balance with 10-lb whd and PD fuze.
3. 10-lb whd and PD fuze.
4. Includes 17 rockets with 17-lb whd and 4 flechette whd, balance with 10-lb whd.
5. Includes 12 rockets with 17-lb whd and PD fuze, balance with 10-lb whd and PD fuze.

Table 13-4. 40mm Ammunition Requirements for Aerial Gunnery

Armament subsystem	Helicopter	40mm launcher	Ammunition (No. of rounds per individual)		
			Initial qualification	Annual qualification	Familiarization
			CTG HE. 40mm	CTG HE. 40mm	CTG HE. 40mm
M28A1	AH-1G	M129	300	850	150
M5	UH-1B/C/M	M75	450	450	150

Table 13-5. Period 1, Initial Qualification Firing—M27E1 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity 7.62mm TR 4-1, MLB*	Altitude above ground level (feet)	Airspeed (knots)	Targets
1	Boresight check and diving.	400-750	4/125/500	600-50	80-100	1-2 guns will be boresighted. Student will not adjust elevation of guns after boresight.
2	Diving.....	300-750	4/125/500	600-50	80-100	1-2.
3	Diving to running....	300-1,000	4/250/1,000	400-50	80-100	2-4-20° left and right. Two bursts firing 4,000 shots per minute.
4	Hovering.....	300-700-1,000	1,000	Nap-of-the-earth.	0	2.
Total rounds of ammunition.....			3,000			

*Firing runs/burst per run/total rounds.

(1) Exercise 1, boresight check and diving fire.

(a) *General.* Exercise 1 consists of a static boresight check and two diving fire runs. Student performance will be critiqued by the instructor pilot following each firing run. Targets within tracer burnout range will be engaged.

(b) Procedures.

1. Loading, preflight, and cockpit procedures.
2. Boresight check procedures to include hand signals to the ground crew (fig 13-2).
3. Burst control/ammunition management.
4. Gunnery flight techniques for diving fire.
5. Use of the system and M70 sight in the stowed mode at varying ranges.
6. Range estimation.
7. Effects of aircraft control on burst.

(2) Exercise 2, diving fire.

(a) *General.* Exercise is a continuation of exercise 1 and consists of four diving fire runs, engaging one or two targets per run. Only targets within maximum effective range (1,000 meters) will be engaged.

(b) Procedures.

1. Development of initial sight picture.
 2. Subsequent sight picture adjustments using burst-on-target technique.
 3. Effects of altitude, airspeed, range, and angle of attack on the beaten zone.
 4. Engagement and disengagement ranges.
 5. The problems encountered in exceeding a 15° dive angle (demonstration).
 6. Recovery from high rates of descent.
- (3) Exercise 3, diving to running fire.*

(a) *General.* Exercise 3 serves as an informal check of the student's level of proficiency in diving fire with the M27E1 subsystem and introduces him to running fire. The instructor pilot will demonstrate the maximum firepower of the system and the student will fire one firing run at maximum fire power (4,000 shots per minute).

(b) Procedures.

1. Effects of low-angle fire on the beaten zone.
2. Trigger switch operation as it relates to the control of the firepower of the system.
3. Hazards of gunnery at nap-of-the-earth.
4. Proper planning.
5. Transition from diving to running fire.
6. Yaw effect.

b. Period 2. 1 hour and 30 minutes dual flight time (table 13-6).

(1) Exercise 4, boresight check and diving fire.

(a) *General.* Exercise 4 introduces the student to night boresight check and diving fire. During this exercise, the weapon will be fired in the stowed mode. Targets will be engaged within tracer burnout range. The instructor pilot will use this as a means of teaching range estimation using tracer bounce. Throughout this exercise and during the rest of the firing table, the minimum altitude of 200 feet absolute will not be penetrated. Targets will be marked by flare pots. In addition, aircraft lighting configuration will be explained during briefing.

(b) Procedures.

1. Loading, preflight, and cockpit procedures for night firing.

Table 13-6. Period 2, Initial Qualification Firing —M27E1 Armament Subsystem (Night)

Exercise	Type of fire	Target range (meters)	Ammunition quantity 7.62mm TR 4-1, MLB*	Altitude above ground level (feet)	Airspeed (knots)	Targets
4	Boresight check and diving.	300-750	4/125/500	600-200	80-120	1-2 stowed—blackout.
5	Diving-----	600-1,000	4/125/500	600-200	80-120	1-2 stowed—searchlight or flares.
6	Level-----	600-1,000	4/125/500	600	80-120	3-4 targets, flexible searchlight or flares.
7	Level to diving-----	300-1,000	4/125/500	600-200	80-120	3-4 targets, stow and flexible—searchlight or flares.
Total rounds of ammunition-----			2,000			

*Firing runs/burst per run/total rounds.

2. Boresight check procedures.

3. Techniques of fire for night operations.

4. Range estimation using tracer bounce.

5. Patterns and safety procedures for night firing.

6. Crew responsibilities.

7. Problems of target fixation.

(2) *Exercise 5, diving fire.*

(a) *General.* Exercise 5 continues with diving fire introducing the student to simulated battlefield conditions with illumination by artillery illuminating rounds. Targets will also be engaged through the use of aircraft searchlight (firefly) and under blackout conditions. During this exercise, the student is exposed to the problems of range estimation at night.

(b) *Procedures.*

1. Techniques of night firing using artillery or aircraft illumination.

2. Adjustment of illumination.

3. Use of offcenter vision to conserve night vision.

4. Aircraft lighting techniques.

5. Range estimation.

6. Emphasis on minimum recovery altitude.

(3) *Exercise 6, level fire (constant altitude).*

(a) *General.* Exercise 6 is conducted at a constant altitude to simulate proposed methods of neutralization fire while conducting a reconnaissance using illumination. During this exercise, the student will use the depression capability of the system to engage targets designated by the instructor pilot.

(b) *Procedures.*

1. Techniques used to deny enemy observation of attacking helicopter using illumination.

2. Techniques of level fire.

3. Use of offcenter vision to conserve night vision.

4. Target acquisition at night.

(4) *Exercise 7, level to diving fire.*

(a) *General.* Exercise 7 is an informal review of all of the preceding exercises. The student is required to demonstrate his knowledge of night gunnery techniques and to conduct all radio transmissions.

(b) *Procedures.*

1. Review of all previous teaching points.

2. Pilot-observer coordination.

3. Emphasis on minimum altitude.

4. Transition from level to diving fire.

5. Techniques of diving fire.

c. *Period 3.* 1 hour and 30 minutes dual flight time (table 14-7).

(1) *Exercise 8, boresight check and diving fire.* Exercise 8 consists of boresight and diving fire in the stow mode. The student will be required to conduct boresight check and diving fire while demonstrating his ability to perform the aircraft maneuvers and gunnery techniques. Diving fire will be initiated at 600 feet absolute and 80 to 120 knots. He will be directed to fire at a series of two to three targets at varying ranges between 200 to 750 meters, which will require a 20° aircraft heading change. Approximately 500 rounds of 7.62mm ammunition should be expended on this exercise.

(2) *Exercise 9, diving to running fire.* Exercise 9 will require the student to transition from diving to running fire. During this exercise, he will demonstrate the aircraft maneuvers and gunnery techniques of both diving and running fire. Demonstration of evasive maneuvers and target attack principles will also be included in this exer-

Table 13-7. Period 3, Initial Qualification Record Firing—M27E1 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity 7.62mm, TR 4-1, MLB ^a	Altitude above ground level (feet)	Airspeed (knots)	Targets
8	Boresight check and diving. ^b	300-750	4/125/500	600-50	80-120	2-3 targets, stowed.
9	Diving to running	300-1,000	4/125/500	600	80-120	3-4 targets, stowed.
10	Running	300-750	4/125/500	50	80-120	3-4 targets, stowed.
11	Level to diving ^c	300-1,000	4/125/500	600-200	80-120	2-3 targets, flexible.
Total rounds of ammunition			2,000			

^a Firing runs/burst per run/total rounds.^b Hover fire may be demonstrated.^c One run of level to diving to running fire may be used with racetrack.

cise. Diving fire will be initiated at 600 feet absolute and 80 to 120 knots. During the dive, he will be required to engage from one to two targets with recovery at approximately 100 feet absolute. Running fire will be initiated from a diving pattern and will be conducted at low level, engaging three to four targets requiring aircraft heading changes of 20°.

(3) *Exercise 10, running fire.* Exercise 10 is running fire and will be conducted at low level to 100 feet absolute and 80 to 120 knots airspeed. The student will be directed to engage from one to four targets at ranges from 200 to 750 meters. Approximately 500 rounds of 7.62mm ammuni-

tion should be expended on this exercise. All runs in this exercise will require variations of aircraft heading of 20° left and right.

(4) *Exercise 11, level to diving fire.* Exercise 11 is the last exercise of this table and consists of level to diving fire. The student will use the flexible capability of the system by adjusting the gun elevation for range corrections. Level fire will be conducted at 600 feet absolute and 80 to 120 knots airspeed from which he will transition into diving fire. He will be directed to engage two to three targets per firing run. Approximately 500 rounds of 7.62mm ammunition should be expended on this exercise.

Section VIII. UH-1B/C/M HELICOPTER GUNNERY INITIAL QUALIFICATION RANGE FIRING

13-45. General

This section is a guide for unit commanders to initially qualify aviators in the M5 and M21 armament subsystems. The presentation pattern and standard radio calls (fig 13-4) are a guide for the instructor pilot and student as to "WHEN" to say "WHAT." Local modification of the methods and techniques used here may be made at the discretion of the unit commander.

13-46. Sequence of Events

- Student briefing.
- Preflight aircraft and weapons systems.
- Formation takeoff.
- Flight to range in tactical formation.
- Perform range sweep.
- Land at firing line and load systems.
- Harmonize and test fire weapons (guns only).

h. Firing table—student number one. Student number two observes from jump seat.

i. Refuel and reload.

j. Harmonize and test fire (guns only).

k. Firing table—student number two. Student number one observes from jump seat.

l. Instructor physically checks all weapons clear.

m. Prescribed return to staging area in tactical formation.

n. Debriefing.

13-47. Guideline

- Instructions.* The following are required:
 - Range briefing (firing safety).
 - Boresight, harmonization, and/or combat sight setting procedures.
 - Type of fire.

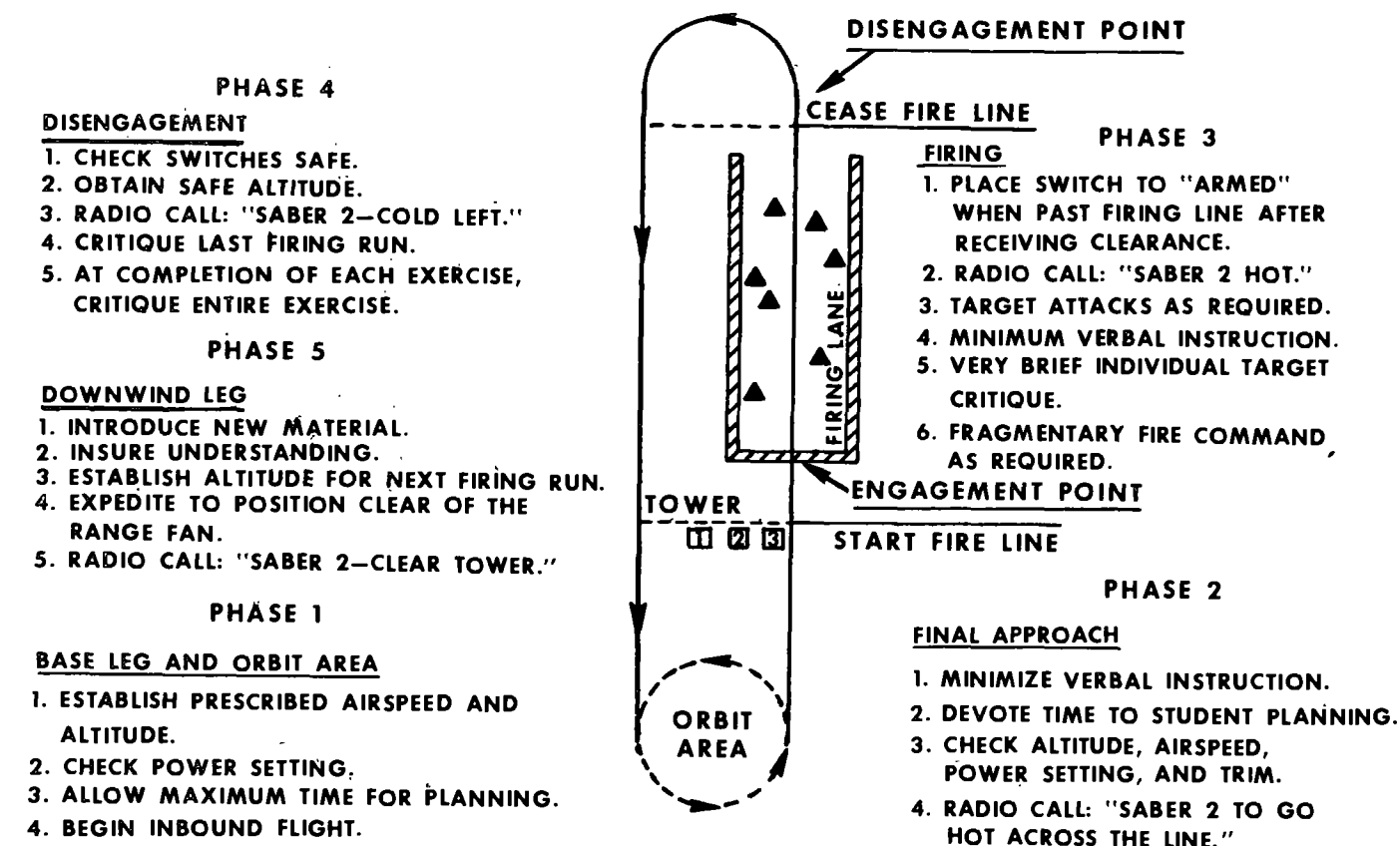


Figure 13-4. Presentation pattern and standard radio calls.

(a) Definition and explanation (para 13-11a).

(b) Target(s) to be engaged.

(c) Critique of maneuver.

(4) Teaching points.

(a) Range estimation.

(b) Burst control (system correlation).

(c) Aiming point.

(5) Principles of air-to-ground fire.

(6) Common student errors.

b. Weapons Systems.

(1) 40mm (M5 system, flex mode):

(a) Boresight check.

1. Purpose. To insure that sight is alined with bore of weapon and to check gun operation.

2. Procedure.

(a) Place armament system on and in "SAFE" position.

(b) Set rounds counter.

(c) Receive clearance from tower and place switch in "HOT" position.

(d) Place reticle on target corresponding to estimated range to the target.

(e) Fire 3 to 5 rounds and adjust sight picture to correct for errors in range estimation and deflection.

(f) Fire subsequent 3- to 5-round bursts to place rounds on target.

(g) Reset system to "SAFE" position.

(b) Diving fire. Analysis:

1. Estimate slant range to target and place corresponding range line on target.

2. If estimated range is beyond limits of "LOW" sight reticle, place switch to "HIGH" sight reticle.

3. Because of constant angle of flight to target, subsequent firing will require only slight range corrections.

4. To acquire a concentrated beaten zone, maintain initial sight picture.

5. Common student errors.

(a) Improper range estimation.

(b) Burst control (less than 3 rounds, more than 5 rounds).

(c) Failure to correct sight picture for error found in boresight check.

(d) Failure to track target between bursts.

(e) "Walking" the rounds to the target.

(c) Running fire. Analysis:

1. Estimate range to target and place corresponding range line on target.

2. Use "high" sight reticle if necessary.

3. Because of the constant altitude and closure on the target, bold corrections for range are required for subsequent firing.

4. Elongated beaten zone. To acquire a concentrated beaten zone, the sight must be "rolled" down as the aircraft closes on the target.

5. Common student errors.

(a) Improper range estimation.

(b) In burst control, firing less than 3 rounds or more than 5 rounds.

(c) Failure to correct sight picture for error found in boresight check.

(d) Failure to track target between bursts.

(e) "Walking" the rounds to the target.

(f) Failure to make bold corrections for errors.

(d) *Diving to running.* Analysis:

1. The procedures for diving to running fire are the same as for diving fire and running fire ((b) and (c) above).

2. Upon completion of diving fire portion, insure transition to running fire technique.

(e) *Banking fire.* Analysis:

1. Elevation becomes deflection; deflection becomes elevation.

2. Aiming point is high and opposite the direction of turn.

3. Common student errors.

(a) Improper range estimation.

(b) Failure to correct sight picture for error found in boresight check.

(c) Failure to track the target between bursts.

(d) Failure to compensate for the bank of the helicopter in relation to the target.

(2) 7.62mm (M21, M134 automatic gun, flex mode).

(a) *Boresight check.*

1. Purpose: To insure the sight is aligned with bore of weapon and to check gun operation.

2. Procedure:

(a) Armament system on and in "SAFE" position.

(b) Select a target approximately 700 meters from the firing line. This will be 50 meters short of tracer burnout.

(c) Release the sighting station from its overhead stowed position, making sure suspension linkage is "LOCKED" securely to the overhead mounting bracket.

(d) Alert ground crew that sight is in the operational position.

(e) Receive clearance from tower and place switch in the "HOT" position, adjusting reticle to the desired intensity.

(f) Stabilize the "pipper" on the harmonization target approximately 700 meters downrange.

(g) The ground crew will align the gun with the harmonization target.

(h) Insure personnel are clear of the weapon and test-fire the gun utilizing a 1- to 3-second burst.

(i) Repeat steps (e) through (h) above until all rounds impact on target.

(j) Repeat steps (e) through (h) above for the right gun.

(k) Test-fire the system utilizing both guns.

(l) Place switch in the SAFE position and dismiss the ground crew.

(b) *Diving fire.* Analysis:

1. Estimate slant range to target and adjust the sight accordingly (aiming point will be slightly high if range is beyond 700 meters; slightly low if range is closer than 700 meters).

2. Because of the constant angle to the target, subsequent firing will require only slight range corrections.

3. Concentrated beaten zone (desired).

4. Common student errors.

(a) Improper range estimation.

(b) Burst control. (A burst of less than 1 second tends to jam the weapon. An interrupter switch will cut the burst at 3 seconds.)

(c) Failure to track the target between bursts.

(d) "Walking" the rounds to the target.

(e) Failure to track target. (Release the actuator bar and the trigger simultaneously. The trigger should be released first and the actuator bar released when the gun ceases to fire.)

(c) *Running fire.* Analysis:

1. Estimate range to target and adjust the sight picture accordingly.

2. Because of the constant altitude and closure on the target, bold corrections for range are required for subsequent bursts.

3. Elongated beaten zone. (To acquire a concentrated beaten zone, the sight must be "rolled" down as the helicopter closes on the target.)

4. Common student errors.

(a) Improper range estimation.

(b) Burst control.

(c) Failure to track target between bursts.

(d) "Walking" the rounds to the target.

(e) Releasing the trigger and actuator bar simultaneously.

(d) *Diving to running fire.* Analysis: The procedures of diving to running fire are the same as diving fire and running fire. Upon completion of diving fire portion, insure transition to running fire technique.

(e) *Banking fire.* Analysis:

1. Elevation becomes deflection; deflection becomes elevation.

2. Aiming point is high and to the opposite direction of the turn.

3. Common student errors: Failure to increase correction with increased deflection.

(3) *Rocket fire (M21, 2.75-inch FFAR stowed fire).*

(a) *Combat sight setting.*

1. Purpose: To adjust the sight to correspond with the rocket tubes at a given slant range.

2. Procedures. Analysis:

(a) Select a target approximately 1,250 meters slant range. Determining an accurate sight setting for engagements at midrange (1,250 meters) insures an adequate sight elevation coverage throughout the minimum employable range (300 meters) to the maximum effective range (2,500 meters) spectrum of the 2.75-inch rocket.

(b) Initial altitude 600 feet above ground level (AGL).

(c) Airspeed 60 kt (to allow sufficient time for firing).

(d) Power setting 60 kt (puts approximately a "0" relative wind condition on the rocket tubes when elevated at 103.2 mils).

(e) Apply forward cyclic to initiate a dive on the target (not to exceed 15 degrees).

(f) Aline the pipper with the target and depress the cyclic firing button. Note the burst on the ground.

(g) Move the pipper *TO THE BURST* (example: If the impact is short of the target, move the pipper down exactly to the point of impact).

(h) Repeat this procedure to verify the initial sight correction.

(i) If rounds impact left or right of target, correct sight picture accordingly.

(j) Once accurate fire is obtained upon the selected target, the combat sight setting is complete. No further adjustments should be made.

(b) *Diving fire.* Analysis:

1. Estimate slant range to target. If beyond 1,250 meters, aiming point is above target. If closer than 1,250 meters, aiming point is below target.

2. Because of the constant angle to the target, subsequent firing will require only slight range corrections.

3. Concentrated beaten zone (desired).

4. Common student errors.

(a) Improper range estimation.

(b) Waiting too long before firing.

Due to the UH-1's instability, it is difficult to stabilize the pipper on the target.

(c) Failure to correct for a crosswind. A rule of thumb is: correct 4 mils upwind for every 10 kts of crosswind over 10 kts.

(d) Firing out of trim. (This creates relative wind on one side of the rocket tube and the rocket tends to "seek" (turn into) this relative wind.)

(e) Improper power setting. (Too little power causes the rocket to impact short; too much power causes the rocket to impact long.)

(c) *Running fire.*

1. Normally performed at airspeeds above 60 kts. (This causes the rocket to impact long, requiring the aiming point to be low on the target.)

2. Estimate the range to the target, and adjust the aiming point accordingly.

3. Because of the constant altitude and closure on the target, bold range corrections are required for subsequent firings.

4. Common student errors.

(a) Improper range estimation.

(b) Waiting too long before firing.

(c) Failure to make bold corrections for estimation range.

(d) Failure to correct for a crosswind.

(e) Firing out of trim.

(f) Changing power setting during exercise.

(d) *Diving to running.*

1. The procedures for diving to running fire are the same as diving fire and running fire.

2. Common student errors for 2.75-inch FFAR firing when transitioning to running fire from diving fire.

(a) Failure to increase power.

(b) Failure to adjust aiming point.

(e) *Banking fire.* Analysis:

1. Elevation becomes deflection; deflection becomes elevation.

2. Aiming point is high and to the opposite direction of the turn.

13-48. Gunnery Flight Briefing Outline**a. Preparatory Instructions.**

- (1) Instructor will provide where possible—
 - (a) Mockup of appropriate sighting station.
 - (b) Range chart.
 - (c) Weather information.
 - (d) Aircraft scheduling information.
- (2) Prior to briefing, students should—
 - (a) Be issued appropriate student handouts.
 - (b) Complete study assignment.

b. Presentation.

- (1) *Introduction.*
 - (a) (Attention) Seat students and gain attention.
 - (b) (Need) Point out importance of training period and weapon system concerned to develop student interest.
 - (c) (Scope) Outline events for training period.
 - (d) (Training objectives). Discuss the knowledges and skills outlined for the training period.
- (2) *Body.*
 - (a) Introduction to sighting station to include:
 1. Operational checks.

2. Trigger/actuator bar switch correlation.

3. Sighting and aiming.

4. Range estimation.

(b) Principles of air-to-ground fire for appropriate weapons system.

(c) Introduction to range firing tables (tables 13-8 through 13-15). Prior to firing any qualification table, performance charts contained in appropriate aircraft operator's manuals (55-series-10) must be consulted to insure that table requirements are within allowable safe load limits for the conditions present.

1. Explanation of harmonization or bore-sight techniques as required by appropriate range firing table.

2. Discussion of firing exercises.

(d) Summary of teaching points.

(e) Range briefing and en route procedures to include communications check (see appropriate SOP).

(f) Safety briefing.

(g) Weather briefing.

(h) Aircraft assignment and SOI.

(i) Preflight and conduct of flight period as prescribed by the flight syllabus.

(3) Conclusion.

(a) Debrief students on flight period.

(b) Complete all forms and records.

(c) Assign next study assignment.

Table 13-8. UH-1B/C/M Gunnery—Period 1, Initial Qualification Firing of M21 Armament Subsystem From Flexible Position (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity (7.62mm)	Altitude AGL (feet)	Airspeed (knots)	Remarks
1	Harmonization	400 to 700	500	600 to 200	60 to 90	Helicopter heading varies 0 degree to 20 degrees left and right.
2	Diving	400 to 750	1,000	600 to 200	60 to 90	Engagement azimuths 0 degree to 30 degrees left and right.
3	Running and race-track.	300 to 1,000	1,000	600 to 50	80 to 90	Helicopter heading varies 0 degree to 20 degrees left and right.
4	Diving to running	300 to 1,000	1,500	600 to 50	60 to 90	Engagement azimuths 0 degree to 70 degrees left and right.

Table 13-9. UH-1B/C/M Gunnery—Period 2, Initial Qualification Firing of M5 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity (40mm)	Altitude AGL (feet)	Airspeed (knots)	Remarks
1	Boresight and running.	500 to 1,000	15	600 to 50	0 to 90	Helicopter heading varies 0 degree to 20 degrees left and right.
2	Running-----	500 to 1,200	30	300 to 900	60 to 90	0 degree to 20 degrees left and right.
3	Diving-----	500 to 1,750	30	900 to 200	60 to 90	0 degree to 20 degrees left and right.
4	Diving to running---	500 to 1,200	35	600 to 50	60 to 90	0 degree to 30 degrees left and right.
5	Hovering/slow flight--	300 to 1,000	40	10 to 50	0 to 60	0 degree to 30 degrees left and right.

Table 13-10. UH-1B/C/M Gunnery—Period 3, Initial Qualification Firing of M5 Armament Subsystem (Night)

Exercise	Type of fire	Target range (meters)	Ammunition quantity (40mm)	Altitude AGL (feet)	Airspeed (knots)	Remarks
1	Boresight and running.	500 to 1,200	40	600 to 200	80 to 100	0 degree blackout, flare pots only.
2	Running-----	500 to 1,200	40	600 to 200	80 to 100	0 degree to 20 degrees left and right, blackout.
3	Diving-----	500 to 1,200	40	900 to 200	80 to 100	0 degree to 20 degrees left and right, blackout and flares.
4	Diving to running---	500 to 1,500	30	900 to 200	80 to 100	0 degree to 20 degrees left and right, blackout and flares.

Table 13-11. UH-1B/C/M Gunnery—Period 4, Initial Qualification Record Firing of M5 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity (40mm)	Altitude AGL (feet)	Airspeed (knots)	Remarks
1	Boresight and running.	500 to 1,000	45	600 to 50	80 to 100	0 degree to 30 degrees left and right.
2	Running-----	500 to 1,200	45	300 to 900	80 to 100	0 degree to 45 degrees left and right.
3	Diving-----	500 to 1,750	30	900 to 200	80 to 100	0 degree to 45 degrees left and right.
4	Diving to running---	500 to 1,200	30	600 to 50	80 to 100	0 degree to 20 degrees left and right.

Table 13-12. UH-1B/C/M Gunnery—Period 5, Initial Qualification Firing of M21 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Altitude AGL (feet)	Airspeed (knots)	Remarks
			2.75-in. FFAR	7.62mm			
1	Harmonization combat sight setting.	700 to 1,250	3	200	600 to 50	60 to 90	Helicopter heading varies 0 degree to 20 degrees left and right.
2	Diving-----	700 to 2,000	9	500	600 to 50	60 to 90	0 degree to 20 degrees left and right.
3	Running-----	700 to 1,500	8	700	600 to 50	80 to 100	0 degree to 20 degrees left and right.
4	Diving to running---	700 to 2,000	8	600	600 to 50	60 to 100	0 degree to 20 degrees left and right.

Table 13-13. UH-1B/C/M Gunnery—Period 6, Initial Qualification Firing of M21 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Altitude AGL (feet)	Airspeed (knots)	Remarks
			2.75-in. FFAR				
1	Combat sight setting	1,000 to 1,250	4		600 to 50	60 to 90	0 degree.
2	Diving	500 to 2,500	14		600 to 50	60 to 90	0 degree to 20 degrees left and right.
3	Running	500 to 2,500	12		600 to 50	80 to 90	0 degree to 20 degrees left and right.
4	Diving to running	500 to 2,500	12		600 to 50	60 to 90	Familiarization. ^a

^a Demonstration by instructor pilot to familiarize student gunner with diving to running fire with rockets.

Table 13-14. UH-1B/C/M Gunnery—Period 7, Initial Qualification Firing of M21 Armament Subsystem (Night)

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Altitude AGL (feet)	Airspeed (knots)	Remarks
			2.75-in. FFAR	7.62mm			
1	Harmonization and combat sight setting.	700 to 1,250	3	200	600 to 200	60 to 90	0 degree flare illumination or blackout.
2	Diving	2,500 to 300	9	600	600 to 200	60 to 90	Illumination or blackout.
3	Running	500 to 2,000	9	600	600 to 200	80 to 90	Illumination or blackout.
4	Diving to running	500 to 2,000	7	600	600 to 200	60 to 90	Illumination or blackout.

Table 13-15. UH-1B/C/M Gunnery—Period 8, Qualification Record Firing of M21 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Altitude AGL (feet)	Airspeed (knots)	Remarks
			2.75-in. FFAR	7.62mm			
1	Harmonization and combat sight setting.	700 to 1,250	3	200	600 to 50	60 to 90	0 degree.
2	Diving	300 to 2,500	8	400	600 to 50	60 to 100	0 degree to 20 degrees left and right.
3	Running	300 to 2,500	7	500	600 to 50	80 to 100	0 degree to 20 degrees left and right.
4	Diving to running	1,000 to 2,500	8	500	600 to 50	60 to 100	0 degree to 20 degrees left and right.
5	Diving	1,000 to 2,500	6	400	600 to 50	60 to 100	Familiarization. ^a

^a Familiarization firing with 2 rockets with 17-lb M229 warheads, 2 rockets with M429 proximity fuzes, and 2 rockets with WDU 4A/A flechette warheads.

Section IX. AH-1G HELICOPTER GUNNERY INITIAL QUALIFICATION RANGE FIRING

13-49. General

This section is a guide to initially qualify aviators in the AH-1G armament subsystems. Local modification of the methods and techniques described herein may be made at the discretion of the unit commander.

13-50. Terms and Definitions

a. Diving Fire. Fire delivered from a helicopter

while descending in altitude toward the target. The angle of attack is constant in relation to the centerline of the helicopter.

b. Running Fire. Fire delivered while the helicopter is in level flight at any altitude. A relatively constant altitude and airspeed is maintained.

c. Running to Diving Fire. A combination of diving fire and running fire.

d. Hovering Fire. Fire delivered from a helicopter at a stabilized altitude with zero groundspeed.

e. Slow Fire. Fire delivered from a helicopter at an airspeed of 0 to 40 knots.

f. Deflection Fire. The gunbore line and helicopter centerline are *not* parallel.

g. Harmonization. The process of alining weapons so that the rounds impact at the sighting point for a given range.

h. Nap-of-the-Earth Flight. Flight at an altitude of 0 to 50 feet absolute.

i. Low-Level Flight. Flight at an altitude of 50 to 300 feet absolute.

Note. Definitions *h* and *i* are not as yet official Army terminology.

13-51. Subsystems Qualification

For an aviator to qualify in AH-1G attack helicopter armament subsystems, he should thoroughly understand the operation and the tactical use of the AH-1G weapons system. The following items are recommended for training an aviator for the attack helicopter role. For information on these items, see the index and appendix A.

a. Gunnery Proficiency.

(1) Loading, preflight, and cockpit procedures for day and night firing of all AH-1G weapons subsystems.

(2) Boresight procedures and hand signals to ground crews (fig 13-2).

(3) Burst control.

(4) Ammunition management.

(5) Gunnery flight techniques for diving, running, hovering/slow flight, and nap-of-the-earth firing runs.

(6) Armament subsystems introduction—assembly, disassembly, and troubleshooting.

(7) Range estimation.

(8) Development of sight pictures.

(9) Burst on target techniques.

(10) Effects of airspeed, altitude, and angle of attack on the beaten zone.

(11) Engagement and disengagement ranges.

(12) Flying techniques and methods for firing in a steep dive, in a nap-of-the-earth environment, and in transition from diving to running.

(13) Proper planning.

(14) Yaw effect.

(15) Target transition.

(16) Engagement, disengagement, and evasive maneuvers.

(17) Night firing techniques.

(a) Range estimation.

(b) Safety factors in night operations.

(c) Techniques of using artillery or aircraft illumination.

(d) How to conserve night vision.

(e) Aircraft lighting techniques.

b. Tactical Proficiency.

(1) Fire team tactics.

(2) Low and high level navigation.

(3) Nap-of-the-earth flying.

(4) Evasive flying techniques.

(5) Map reading.

(6) Tactical flight planning.

(7) Reporting procedures.

(8) Hover/slow flight techniques.

(9) Radio security procedures.

13-52. Range Firing Tables

The range firing tables (tables 13-16 through 13-22) are recommended for AH-1G weapons subsystems aerial gunnery qualification training. These tables are to qualify aviators with both the AH-1G turret and wing mounted weapons subsystems. The tables provide guidelines for weapons subsystem qualification. Prior to firing any qualification table, performance charts contained in appropriate aircraft operator's manuals (55-series-10) must be consulted to insure that table requirements are within allowable safe load limits for the conditions present. These tables may be changed at the discretion of the unit commander. For ammunition requirements, see section V. For information on firing ranges, see paragraphs 13-1 through 13-32. For helicopter aerial gunnery safety regulations, see AR 385-63.

13-53. Aerial Gunnery Flexible Weapons Qualification Firing Exercises From Gunner's (Copilot's) Seat

a. Range Orientation. Range and gunnery orientation is to include safety precautions and procedures, traffic patterns and procedures, approach to range pads, and gunnery flight techniques to include high-speed maneuvers and simulated target engagement, emergency procedures, and forced landings.

(1) *References.*

(a) Checklist.

(b) SOP.

(c) TM 1-260.

(d) TM 55-1520-221-10 (AH-1G operator's manual).

(e) FM 1-100.

(2) *Exercises.*

(a) 5 hours practical exercise.

(b) 1 hour and 15 minutes dual flight time.

b. Turret Initial Qualification. A practical exercise in gunnery techniques of firing and aircraft maneuvers is necessary to train the aviator in the employment of the M28A1 flexible turret subsystem, to include preflight procedures; cockpit procedures; loading, arming, and disarming procedures; live firing techniques; forced landings; and emergency procedures. An automatic scoring device may be used.

(1) *References.*

(a) Checklist.

(b) TM 55-1520-221-10 and TM 55-1520-221-20.

(c) FM 1-100.

(2) *Turret initial qualification.*

(a) 6 hours practical exercise.

(b) 1 hour and 30 minutes dual flight time (table 13-16).

(c) Fire M28A1 in bursts of no less than 3 seconds.

Caution: Do not fire 40mm ammunition from the line and do not fire 40mm ammunition at less than 500 meters slant range.

13-54. Aerial Gunnery Stowed Weapons Initial Qualification Firing Exercises From Pilot's Seat

Practical exercises in gunnery techniques and aircraft maneuvers are necessary to train the aviator in the employment of the M18A1 pods, M35 armament subsystems, and M200A1 rocket launchers, to include preflight procedures; loading, arming and disarming procedures; live firing techniques; forced landings; and emergency procedures.

a. References.

(1) Checklist.

(2) TM 55-1520-221-10.

(3) FM 1-100.

b. Stowed Weapons Initial Qualification (Pilot's Seat).

(1) 10 hours practical exercise.

(2) 7 hours dual flight time (tables 13-17 through 13-20).

(a) *Period 2.* 1 hour and 30 minutes (table 13-17).

(b) *Period 3.* 1 hour and 30 minutes (table 13-18).

(c) *Period 4.* 1 hour and 30 minutes (table 13-19).

(d) *Period 5.* 1 hour and 15 minutes (table 13-20).

Table 13-16. *Period 1, Turret Initial Qualification Familiarization and Record Firing From Gunner's Seat—M28A1 Armament Subsystem (Day)*

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
			7.62mm	40mm				
1	Harmonization.....	700-800	300	0	Static	NA	1	Harmonize.
2	Diving.....	1,200-300	1,000	0	1,200-500	100-140	1-2	Flex 20° left and right.
3	Running.....	1,200-300	1,000	0	1,200-200	100-150	2-3	Flex 45° left and right.
4	Hovering.....	800-300	1,000	0	0-100	0	2-3	Flex 70° left and right.
5	Diving.....	1,200-500	0	100	800	80-100	1-2	Harmonize.
6	Running.....	1,200-500	0	100	1,000-200	100-150	2-3	Flex 45° left and right.
7	Hovering.....	1,500-500	700	100	0-100	0	2-3	Flex 70° left and right.
Total rounds of ammunition.....			4,000	300				

Table 13-17. Period 2, Stowed Weapons Initial Qualification Firing From Pilot's Seat—M200A1 Rocket Launchers (Day)

Exercise	Type of fire	Target range (meters) ^a	Ammunition quantity	Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
			2.75-in. FFAR (inert)				
1 ^b	Diving.....	1,500	1	900	130	1	Obtain combat sight setting.
2	Diving.....	1,400-700	2	1,200-700	100-160	1	
3	Running.....	1,400-500	3	1,000-200	100-160	1	
4	Running NOE— (nap-of-the-earth).	1,500-700	6	0-200	100-160	1	
5	Hovering.....	1,000-500	6	0-100	0	1	
Total rounds of ammunition.....			18				

^a Do not fire rockets at less than 500 meters slant range.^b Repeat exercise number 1 as necessary.

Table 13-18. Period 3, Stowed Weapons Initial Qualification Firing From Pilot's Seat—M18A1 Pods/M200A1 Rocket Launchers (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
			7.62mm	2.75-in. FFAR (flechette) ^b				
1	Diving.....	1,000 or less.	300		900	130	1	Obtain combat sight setting.
2	Diving.....	1,200-500	300		1,200-500	100-150	1	
3	Diving.....	1,500-500	300		1,500-500	100-160	1	
4	Diving to running	1,500-500	300		1,700-500	100-160	2	
5	Diving to running	1,500-500	300		1,200-500	100-150	2	
6 ^c	Diving.....	1,250	0	1	900	130	1	180° turn. Obtain combat sight setting.
7	Running.....	1,200-700	0	2	1,000-200	100-160	1-2	
8	Hovering.....	1,500-700	0	1	0-100	0	1	
Total rounds of ammunition.....			1,500	4				

^a Fire 7.62mm ammunition from M18A1 pods in bursts of no less than 3 seconds.^b Do not fire flechette at less than 700 meters slant range.^c Repeat exercise number 6 as necessary.

Table 13-19. Period 4, Stowed Weapons Initial Qualification Firing From Pilot's Seat—M18A1 Pods/M200A1 Rocket Launchers (Day)

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
			7.62mm ^a	2.75-in. FFAR HE 17 lbs ^b				
1 ^c	Diving.....	1,000 or less.	0	1	900	130	1	Obtain combat sight setting.
2	Diving.....	1,400-500	300	0	1,200-700	100-160	1	
3	Diving.....	1,500-500	300	4	1,500-500	100-160	1	
4	Running ^d	1,500-500	300	4	1,000-200	100-160	1-2	Obtain combat sight setting for low altitude rocket attack.
5	Running ^d	1,700-500	300	4	1,000-200	100-150	2	
6	Hovering.....	1,700-500	300	4	0-100	0	1	180° turn.
Total rounds of ammunition.....			1,500	17				

^a Fire 7.62mm ammunition from M18A1 pods in bursts of no less than 3 seconds.^b Do not fire HE warhead rockets at less than 500 meters slant range.^c Repeat exercise number 1 as necessary.^d During first portion of running engagement 2.75-in. FFAR will be fired, and during last portion of engagement 7.62-mm ammunition will be fired.

Table 13-20. Period 5, Stowed Weapons Initial Qualification Firing From Pilot's Seat—M35 Armament Subsystem (Day)

Exercise	Type of fire	Target range (meters) ^a	Ammunition quantity 20mm	Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
1 ^b	Diving.....	2,000-1,500	50	3,000-1,500	100-130	1	Obtain combat sight setting.
2	Diving.....	2,000-1,500	50	3,000-1,500	100-160	1-2	
3	Diving to running....	2,000-1,500	100	1,500-500	100-160	1-2	
4	Hovering.....	3,000-1,000	50	0-100	0	1	
Total rounds of ammunition.....			250				

^a Do not fire 20mm ammunition at less than 500 meters slant range.

^b Repeat exercise number 1 as necessary.

Table 13-21. Period 6, Stowed Weapons Initial Qualification Firing From Pilot's Seat—M18A1 Pods/M200A1 Rocket Launchers (Night)

Exercise	Type of fire	Target range ^a (meters)	Ammunition quantity		Flight altitude ^d (feet)	Airspeed (knots)	Targets per exercise	Remarks
			7.62mm ^b	2.75-in. FFAR HE 10 lbs ^c				
1 ^e	Diving.....	1,000 or less.	0	1	500	130	1	Obtain combat sight setting.
2	Diving.....	1,500-700	300	0	1,500-900	100-150	1	Do not adjust sight.
3	Diving.....	1,700-700	300	0	1,700-900	100-150	1	
4	Diving to running....	1,700-700	300	2	1,500-500	100-150	1	
5	Running.....	1,700-700	300	4	400	100-150	2	
6	Hovering.....	1,700-700	300	2	0-100	0	2	
Total rounds of ammunition.....			1,500	9				

^a Artificial illumination must be provided for range alignment.

^b Fire 7.62mm ammunition from M18A1 pods in bursts of no less than 3 seconds.

^c Do not fire HE warhead rockets at less than 500 meters slant range.

^d Make all breaks prior to reaching 500 feet altitude.

^e Repeat exercise number 1 as necessary.

13-55. Night Aerial Gunnery Stowed Weapons Exercises From Pilot's Seat

Practical exercise in gunnery techniques and aircraft maneuvers is necessary to familiarize the student in the employment of the M18A1 pods and M200A1 rocket launchers at night, to include preflight procedures; cockpit procedures; loading, arming and disarming procedures; live firing techniques; and emergency procedures.

a. References.

- (1) Checklist.
- (2) TM 55-1520-221-10.
- (3) TM 55-1520-221-20.
- (4) FM 1-100

b. Night Stowed Weapons Initial Qualification (Pilot's Seat).

- (1) 5 hours practical exercise.
- (2) 1 hour and 15 minutes dual flight time (table 13-21).

(3) Artificial illumination must be provided for range alignment.

13-56. Record Firing—Gunnery Checkride (Pilot's Seat)

The stowed weapons initial qualification record firing from pilot's seat (table 13-22) is a graded 6-hour practical exercise that requires the student to demonstrate his skills in the execution of selected gunnery techniques and aircraft maneuvers in the employment of the AH-1G. The record firing is to include firing the M18A1 pods and M200A1 rocket launchers.

a. References. All previous references.

b. Record Firing (Pilot's Seat).

- (1) 6 hours practical exercise.
- (2) 1 hour and 30 minutes dual flight time (table 13-22).

Table 13-22. *Period 7, Stowed Weapons Initial Qualification Record Firing From Pilot's Seat—M18A1 Pods and M200A1 Rocket Launchers (Day)*

Exercise	Type of fire	Target range (meters)	Ammunition quantity		Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
			7.62mm ^a	2.75-in. FFAR HE 10 lbs ^b				
1 ^c	Diving.....	1,000 or	0	1	1,500	130	1	Obtain combat sight setting.
2	Diving.....	1,400-700	300	0	1,200-700	100-160	1	Do not adjust sight.
3	Diving.....	1,500-500	300	4	1,500-500	100-160	1	
4	Diving to running ^d ...	1,500-500	300	4	1,500-500	100-160	1-2	
5	Running ^e	1,700-500	300	4	1,000-200	100-150	2	180° turn.
6	Hovering.....	1,700-500	300	4	0-100	0	1	
Total rounds of ammunition.....			1,500	17				

^a Fire 7.62mm ammunition from M18A1 pods in bursts of no less than 3 seconds.

^b Do not fire HE warhead rockets at less than 500 meters slant range.

^c Repeat exercise number 1 as necessary.

^d On diving to running fire, 2.75-in. FFAR will be fired in dive and 7.62mm ammunition in last portion of dive or during running engagement.

^e During first portion of running engagement, 2.75-in. FFAR will be fired, and during last portion of engagement, 7.62mm ammunition will be fired.

13-57. Ammunition

The ammunition required for AH-1G helicopter range firing tables is as follows—

Table No.	M28A1 turret		M18A1 pods	M200A1 rocket launchers	M35 armament subsystem
	Ctg. ball, 7.62mm, TR 4-1, MLB	Ctg. HE, 40mm Gren	Ctg. ball, 7.62mm, TR 4-1, MLB	2.75-in. FFAR	Ctg. 20mm, Target, Practice, MLB
13-16.....	4,000	300			
13-17.....				18 (inert)	
13-18.....			1,500	4 (flechette)	
13-19.....			1,500	17 (17 lb)	
13-20.....					250
13-21.....			1,500	9 (10 lb)	
13-22.....			1,500	17 (10 lb)	
Totals.....	4,000	300	6,000	65.....	250

Section X. AH-1 AND UH-1 GUNNERY ANNUAL QUALIFICATION RANGE FIRING

13-58. General

This section is a guide for conducting annual qualification firing for aircrews of attack helicopter units, both active Army and Reserve components, except for air cavalry attack helicopter units organized under 17-series TOE. For these units, see TC 17-17. This section consists of a 5-day annual unit gunnery qualification course to include qualification tables, range requirements, aircraft/weapons systems, and ammunition requirements. The unit commander has flexibility in

the use of the proposed firing tables based on specific unit/personnel qualification requirements. This section provides guidance to the commander and gives a reliable measure of the proficiency of his attack helicopter crews and a reasonable assurance of their effectiveness in combat.

13-59. Aircraft/Weapon Systems Requirements

a. Aircraft requirements will depend on the number of aviators to be qualified, location of re-

fueling/rearming points with respect to firing ranges, and the actual conduct of range firing.

(1) The optimum situation would require four mission-ready attack helicopters in operation at all times. This would allow for one aircraft on a live fire run, one clear of the range fan en route to the holding area, one in the holding area awaiting clearance down range, and one at the rearming/refueling point.

(2) At least eight aircraft per range must be dedicated to each training cycle. Of the four spare aircraft, two are to allow for avionics and weapons systems malfunctions and two are for maintenance difficulties.

b. Aircraft must be equipped with the following:

(1) Operational turret and wing stores weapons systems.

(2) Suitable night flight equipment.

(3) Operational UHF and FM radios.

c. Prior to firing any qualification table, performance charts contained in appropriate aircraft operator's manuals (55-series-10) must be consulted to insure that table requirements are within allowable safe load limits for the conditions present.

13-60. Individual and Crew Qualification Course Requirements

Prior to arrival at the annual qualification firing course, the aviator must have received formal instruction in the subjects listed below.

a. *Ground School Proficiency.*

(1) Loading, preflight, and cockpit proce-

(1) *AH-1 helicopter.*

Table 13-23—Period 1, Turret Flex-Mode Weapons System (Day)—Familiarization and Practice.

Table 13-24—Period 2, Wing Stores/Mixed Load Weapons System (Day)—Familiarization and Practice.

Table 13-25—Period 3, Wing Stores Weapons System, Nap-of-the-Earth (Day)—Familiarization and Practice.

Table 13-26—Period 4, Wing Stores/Turret Flex-Mode Weapons System (Night)—Night Familiarization and Practice.

Table 13-27—Period 5, Wing Stores/Turret Flex-Mode Weapons System (Day, PM)—Crew Coordination Exercise.

Table 13-28—Period 6, Individual Annual Qualification Record Fire (Day).

Table 13-29—Period 7, Crew Annual Qualification Record Fire (Day).

(2) *UH-1 helicopter.*

Table 13-30—Period 1, M21 Flex-Mode Weapons System (Day)—Familiarization and Practice.

Table 13-31—Period 2, M5 Flex/Stowed Weapons System (Day)—Familiarization and Practice.

Table 13-32—Period 3, M21 Stowed-Mode/Mixed Load Weapons System (Day)—Familiarization and Practice.

dures for day and night firing of all aerial weapons subsystems.

(2) Boresight procedures and hand signals to ground crews.

(3) Burst control.

(4) Ammunition management.

(5) Gunnery flight techniques for diving, running, and nap-of-the-earth firing runs.

(6) Armament subsystems introduction—assembly, disassembly, and troubleshooting.

(7) Range estimation.

(8) Development of sight pictures.

(9) Burst on target techniques.

(10) Effects of airspeed, altitude, and angle of attack on the beaten zone.

(11) Flying techniques and methods for firing in a steep dive, in a nap-of-the-earth environment, and in transition from diving to running flight.

(12) Yaw effect.

(13) Engagement, disengagement, and evasion maneuvers.

(14) Target transition.

(15) Night firing techniques.

(a) Range estimation.

(b) Safety factors in night operations.

(c) Conservation of night vision.

(d) Aircraft lighting techniques.

(16) Range orientation and safety briefing.

b. *Annual Qualification Firing Tables.* Firing tables for both the AH-1 and UH-1 helicopter and for wire-guided missile weapons systems are listed below:

Table 13-33—Period 4, M21 Flex/Stowed Weapons System (Night)—Night Familiarization and Practice.

Table 13-34—Period 5, M21 Flex/Stowed Weapons System (Day, PM)—Crew Coordination Exercise.

Table 13-35—Period 6, Individual Annual Qualification Record Fire (Day).

Table 13-36—Period 7, Crew Annual Qualification Record Fire (Day).

(3) *Wire-guided missile qualification tables (for familiarization only).*

Table 13-37—Period 1, Wire-Guided Missile (DX43 Simulator) (Day).

Table 13-38—Period 2, Wide-Guided Missile (Day).

Table 13-39—Period 3, Wide-Guided Missile (Night).

c. Qualification Schedule.

Day	Responsibility	Objective	Table	NOTES
One	Host Command	Familiarization and practice.	13-23	
Two	Host Command	Familiarization and practice.	13-24	1. Table 13-28 fired with host command evaluator on board aircraft.
Three	Host Command	Familiarization and practice and night familiarization.	13-25, 13-26	2. Only those pilots achieving a passing score during individual qualification record fire will complete table 13-29 (Crew Annual Qualification).
Four	Host Command	Crew Coordination Exercise.	13-27	
Five	Host Command	Record Fire	13-28, 13-29	3. It is proposed that the host commander be granted authority to change or modify tables to suit particular need of individual units and personnel within those units. This applies to both AH-1 and UH-1 gunnery qualifications.

Table 13-23. Period 1, Annual Qualification Firing—Turret Flex-Mode Weapons System (Day)—Familiarization and Practice—AH-1 Helicopter

Exercise	Type of fire	Ammunition quantity					Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs
		Turret		Wing stores							
		7.62mm	40mm	7.62mm	20mm	2.75 in.					
1	Harmonization-----	300	0	N/A	N/A	N/A	600	Static	N/A	1	N/A
2	Hovering/Slow Flight (H/SF).	300	0	N/A	N/A	N/A	1,000-500	Hover-100	0-40	2	1
3	H/SF-----	0	20 ¹	N/A	N/A	N/A	1,000-500	Hover-100	0-40	2	1
4	SF-----	300	20	N/A	N/A	N/A	1,000-500	100	40	2	1
5	H/SF-----	300	20	N/A	N/A	N/A	1,000-500	L/L ²	0-40	2	1
6	H/SF to Moving Tgt.	300	20	N/A	N/A	N/A	1,000-500	L/L	0-40	1	1
7	Diving to running----	600	50	N/A	N/A	N/A	1,500-500	1,500-L/L	0-150	2	2
8	Running-----	600	50	N/A	N/A	N/A	1,000-500	L/L	70-130	2	2
9	Running-----	300	20	N/A	N/A	N/A	1,000-500	NOE ³	70-130	2	1

Ammunition Expenditure: 3,000 7.62mm
200 40mm

¹ 40mm not to be fired at slant ranges of less than 500 meters.

² Low Level- Altitude between 50-300 ft absolute.

³ Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-24. Period 2, Annual Qualification Firing—Wing Stores/Mixed Load Weapons System (Day)—Familiarization and Practice—AH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs
		7.62mm	20mm	2.75 in.					
1	Harmonization.....	200	20	4	1,200-1,000	900	100	1	4
2	Diving.....	200	20	4	2,500-500	1,500	0-150	1	2
3	Running.....	300	20	4	2,500-500	L/L ¹	70-130	2	1
4	Diving to Running.....	300	20	4	2,500-500	1,500-L/L	0-150	2	1
5	Running.....	200	20	4	2,500-500	NOE ²	70-130	2	1
6	Running.....	300	20	4	2,000-500	NOE	60	2	1
7	Diving.....	0	0	6*	2,500-1,000	1,500	0-150	1	2
8	Running.....	0	0	6*	2,000-1,000	NOE	70-130	2	1

Ammunition Expenditures: 1,500 7.62mm
 120 20mm
 24 2.75" HE/PD FFAR
 12 2.75" 17 lb HE/PD FFAR

*2.75" 17 lb HE/PD FFAR.

¹ Low level: Altitude between 50-300 ft absolute.

² Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-25. Period 3, Annual Qualification Firing—Wing Stores Weapons System, Nap-of-the-Earth (Day)—Familiarization and Practice—AH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs
		7.62mm	20mm	2.75 in.					
1	Harmonization.....	200	20	4	1,200-1,000	900	100	1	4
2	Hovering/Slow Flt (H/SF) to Moving Target.	300	20	0	2,000-800	NOE ¹	0-40	1	1
3	SF.....	0	0	4	1,500	NOE	0-40*	1	1
4	H/SF.....	300	20	4	2,000-800	NOE	0-40*	2	1
5	Running.....	300	20	0	2,000-800	NOE	70-130	1	1
6	Running.....	0	0	4	1,500	NOE	70-130	2	1
7	Running.....	400	20	4	2,000-800	NOE	70-130	2	1

Ammunition Expenditures: 1,500 7.62mm
 100 20mm
 20 HE/PD FFAR

*20mm and 2.75 in. FFAR not to be fired below effective translational lift (ETL).

¹ Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-26. Period 4, Annual Qualification Firing—Wing Stores/Turret Flex-Mode Weapons System (Night)—Night Familiarization and Practice—AH-1 Helicopter

Exercise	Type of fire	Ammunition quantity					Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs
		Turret		Wing stores							
		7.62mm	40mm	7.62mm	20mm	2.75 in.					
1	Harmonization-----	200	0	0	0	0	600	Static	N/A	1	N/A
2	Diving to Running----	600	50	0	0	0	750-500	L/L ¹	0-150	2	2
3	Running-----	600	0	0	0	0	750-500	L/L	70-130	2	2
4	Running-----	600	50	0	0	0	750-500	L/L	70-130	3	1
5	Harmonization-----	0	0	200	20	2	1,200-750	900	100	1	2
6	Diving-----	0	0	600	40	6	2,500-500	1,500-500	0-150	2	3
7	Running-----	0	0	700	40	4	2,500-500	L/L	70-130	3	2

Ammunition Expenditures: 3,500 7.62mm
 100 40mm
 100 20mm
 12 2.75 in. HE/PD FFAR
 28 rounds per student of artillery illumination (optional).

¹ Low level: Altitude between 50-300 ft absolute.

Note. Exercises 1-4, student fires turret/flex-mode.

Exercises 5-7, student fires wing stores from rear seat.

Artificial illumination consisting of 28 rounds of artillery illumination (or firefly) required.

Table 13-27. Period 5, Annual Qualification Firing—Wing Stores/Turret Flex-Mode Weapons System (Day, PM)—
Crew Coordination Exercise—AH-1 Helicopter

Exercise	Type of fire	Ammunition quantity				Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs
		Turret		Wing stores						
		7.62mm	40mm	20mm	2.75 in.					
1	Harmonization-----	200	0	0	0	600	Static	N/A	1	N/A
2	Harmonization-----	0	10	20	2	1,200-1,000	900	100	1	2
3	Hovering/Slow Flt/ Running.	900	70	40	6	2,500-500	NOE ¹	0-130*	2	4
4	Hovering/Slow Flt/ Running.	900	70	40	8	2,500-500	NOE	0-130*	3	4
5	Diving/Running-----	500	50	40	6	2,500-500	1,500-NOE	0-150	2	2

Ammunition Expenditures: 2,500 7.62mm
200 40mm
140 20mm
22 2.75 in. HE/PD FFAR

* 20mm and 2.75 in. FFAR not to be fired below effective translational lift (ETL).

¹ Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-28. Period 6, Individual Annual Qualification Record Fire (Day)—AH-1 Helicopter

Exer- cise	Type of fire	Ammunition quantity					Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs
		Turret		Wing stores							
		7.62mm	40mm	7.62mm	20mm	2.75 in.					
1	Harmonization-----	200	0	0	0	0	600	Static	N/A	1	N/A
2	Diving-----	400	25	0	0	0	1,250-500	1,500	0-150	3	1
3	H/SF ¹ -----	300	25	0	0	0	1,250-500	L/L ² -NOE ³	0-40	2	1
4	Running-----	300	25	0	0	0	1,250-500	L/L	70-130	2	1
5	SF/Running-----	400	25	0	0	0	1,250-500	NOE	40-130	3	1
6	Harmonization-----	0	0	100	20	2	1,200-1,000	900	100	1	2
7	H/SF Running-----	0	0	400	0	0	1,000	L/L-NOE	0-130	1	1
8	Diving-----	0	0	0	0	6	2,500-1,000	1,500	0-150	1	1
9	SF/Running-----	0	0	300	100	8	2,500-500	L/L-NOE	40-130	2	2
10	Running-----	0	0	300	100	8	2,500-500	L/L	70-130	2	2
11	H/SF-----	0	0	400	100	6	2,500-500	NOE	0-40	3	1

Ammunition Expenditures: 3,100 7.62mm
100 40mm
320 20mm
30 2.75 in. HE/PD FFAR

*20mm and 2.75 in. FFAR not to be fired below effective translational lift (ETL).

¹ Hovering/Slow Flight.

² Low Level: Altitude between 50-300 ft absolute.

³ Nap-of-the-earth: Altitude below 50 ft absolute.

Note. Exercise 1-5, student fires turret flex-mode.

Exercise 2, all deflection.

Exercise 3, 2 deflection L&R.

Exercise 4, 1 deflection and outside break.

Exercise 5, 2 deflection and inside break.

Exercise 6-11, student fires wing stores rear seat.

Exercise 7, moving target.

Table 13-29. Period 7, Crew Annual Qualification Record Fire (Day)—AH-1 Helicopter

Exer- cise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed) (knots)	Targets per run	No. of runs
		Turret		Wing stores					
		7.62mm	40mm	2.75 in.					
1	Harmonization.....	200	0	0	600	Static	N/A	1/0 ³	N/A
2	Harmonization.....	0	25	2	1,200-1,000	900	100	1/1	1
3	Diving.....	600	0	6	2,500-500	1,500	0-150	2/1	2
4	Running.....	800	50	6	2,500-500	L/L ¹	70-130	3/1	1
5	Diving to Running.....	600	50	6	2,500-500	1,500-L/L	0-150	3/2	1
6	Running.....	500	0	6	2,500-500	NOE ²	70-130	1/2	1
7	Hover to Slow Flt.....	500	0	4	2,500-500	NOE	0-40*	2/1	1
8	Hover to Running.....	300	50	4	2,500-500	NOE-L/L	0-130*	2/1	1
9	Running.....	500	75	6	2,500-500	NOE	70-130	3/2	1

Ammunition Expenditures: 4,000 7.62mm
 250 40mm
 40 2.75 in. HE/PD FFAR

Note. Exercises 5 and 6, flex weapons will engage moving target.

* 2.75 in. FFAR not to be fired below ETL.

¹ Low Level: Altitude between 50-300 ft absolute.

² Nap-of-the-earth: Altitude below 50 ft absolute.

³ Flex tgts/stowed tgts.

Table 13-30. Period 1, Annual Qualification Firing—M21 Flex-Mode Weapons System (Day)—Familiarization and Practice—UH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization-----	0	500	0	600	Static	N/A	1	N/A	None.
2	Diving-----	0	500	0	1,000-500	1,500-500	40-110	2	1	None.
3	Diving to Running---	0	800	0	1,000-500	1,500-L/L ¹	40-110	2	1	2d tgt deflection left or right.
4	Hovering to Slow Flight.	0	800	0	1,000-500	NOE ²	0-40	2	1	Both tgts deflection with one a moving tgt.
5	Slow Flight-----	0	800	0	1,000-500	NOE	40	3	1	Two deflections left and right.
6	Running-----	0	800	0	1,000-500	L/L	60-90	2	1	Both tgts deflection.
7	Running-----	0	800	0	1,000-500	NOE	60-90	3	1	All tgts deflection with one a moving tgt.

Ammunition Expenditures: 5,000 7.62mm

¹ Low Level: Altitude between 50-300 ft absolute.

² Nap-of-the-earth: Altitude below 50 ft absolute.

*Table 13-31. Period 2, Annual Qualification Firing—M5 Flex/Stowed Weapons System
(Day)—Familiarization and Practice—UH-1 Helicopter*

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization.....	20	0	0	750	Static	N/A	1	N/A	None.
2	Diving.....	30	0	0	1,250-500	1,500	40-110	2	1	None.
3	Diving to Running...	50	0	0	1,250-500	1,500-L/L ¹	40-110	2	1	Second tgt deflection left or right.
4	Running.....	50	0	0	1,250-500	NOE ²	60-90	3	1	One stationary deflection, one moving tgt deflection.
5	Slow Flight.....	25	0	0	1,250-500	NOE	40	2	1	Deflections left and right.
6	Hover.....	50	0	0	1,250-500	Hover	N/A	3	1	None.
7	Diving.....	25	0	0	1,250-500	1,500-500	40-110	2	1	Stowed fire.
8	Running.....	25	0	0	1,250-500	L/L	60-90	2	1	Stowed fire, 1 moving tgt.
9	Running.....	25	0	0	1,250-500	NOE	60-90	2	1	Stowed fire, 1 moving tgt.

Ammunition Expenditures: 300 40mm

¹ Low Level: Altitude between 50-300 ft absolute.

² Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-32. Period 3, Annual Qualification Firing—M21 Stowed-Mode/Mixed Load Weapons System (Day)—Familiarization and Practice—UH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization.....	0	500	0	600	Static	N/A	1	N/A	None.
2	Harmonization.....	0	0	2	1,200	600	80	1	1	None.
3	Diving.....	0	1,000	0	1,000-500	1,500-500	40-110	2	1	None.
4	Diving to Running...	0	0	6	2,500-500	1,500-L/L ¹	40-110	2	1	None.
5	Running.....	0	500	2	2,500-500	L/L	60-90	2	1	Engage moving tgt with 7.62 mm.
6	Slow Flight.....	0	500	4	2,500-500	NOE ²	40	2	1	Engage moving tgt with 7.62mm.
7	Diving.....	0	500	*2	2,500-500	1,500-500	40-110	1	1	None.
8	Diving to Running...	0	500	*6	2,500-500	1,500-NOE	40-110	3	1	None.
9	Running.....	0	500	*6	2,500-500	NOE	60-90	3	1	Engage moving tgt with 7.62mm.

Ammunition Expenditures: 4,000 7.62mm
28 2.75 in. HE/PD FFAR

¹ Low Level: Altitude between 50-300 ft absolute.

² Nap-of-the-earth: Altitude below 50 ft absolute.

*2.75-inch 17 lb HE/PD FFAR.

Table 13-33. Period 4, Annual Qualification Firing—M21 Flex/Stowed Weapons System
(Night)—Night Familiarization and Practice—UH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitudes (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization	0	500	0	600	Static	N/A	1	N/A	None.
2	Diving	0	500	0	750-500	1,500-500	40-110	1	1	None.
3	Diving to Running	0	1,000	0	750-500	1,500-L/L ¹	40-110	2	1	Second target deflection left or right.
4	Running	0	1,000	0	750-500	L/L	60-90	3	1	Two deflections left and right.
5	Slow Flight	0	1,000	0	750-500	L/L	40	3	1	Two deflections left and right.
6	Harmonization	0	0	2	1,200	600	80	1	1	None.
7	Diving	0	0	4	2,500-500	1,500-500	40-110	1	1	None.
8	Running	0	0	4	2,500-500	L/L	60-90	1	1	None.
9	Running	0	0	4	2,500-500	L/L	60-90	2	1	None.

Ammunition Expenditures: 4,000 7.62mm
14 2.75 in. HE/PD FFAR.

¹ Low Level: Altitudes between 50-300 ft absolute.

Table 13-34. Period 5, Annual Qualification Firing—M21 Flex/Stowed Weapons System (Day, PM)—Crew Coordination Exercise—UH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitudes (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization	0	500	0	600	Static	N/A	1/0	N/A	None.
2	Harmonization	0	0	2	1,200	600	80	0/1	1	None.
3	Diving	0	1,000	2	2,500-500	1,500-500	40-110	2/1	1	Flex tgts deflections.
4	Running	0	1,000	2	2,400-500	L/L ²	60-90	2/1	1	Flex tgts deflections.
5	Slow Flight	0	1,000	4	2,500-500	NOE ³	40	3/1	1	One flex tgt is moving tgt.
6	Running	0	1,000	4	2,500-500	NOE	60-90	3/2	1	One flex tgt is moving tgt, two stationary deflections.

Ammunition Expenditures: 4,500 7.62mm
14 2.75 in. HE/PD FFAR

¹ Flex tgts/stowed tgts.

² Low Level: Altitude between 50-300 ft absolute.

³ Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-35. Period 6, Individual Annual Qualification Record Fire (Day)—UH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization-----	0	500	0	600	Static	N/A	1	N/A	None.
2	Diving-----	0	1,000	0	1,000-500	1,500-500	40-110	2	1	None.
3	Diving to Running-----	0	1,000	0	1,000-500	1,500-L/L ¹	40-110	2	1	Deflection left and right.
4	Hover to Slow Flight.	0	1,000	0	1,000-500	NOE ²	0-40	3	1	Two deflections and one moving target.
5	Running-----	0	1,000	0	1,000-500	NOE	60-90	3	1	Two deflections and one moving target deflection.
6	Harmonization-----	0	0	2	1,200	600	80	1	1	None.
7	Diving-----	0	0	4	2,500-1,000	1,500-500	40-110	1	1	None.
8	Running-----	0	0	4	2,500-500	L/L	60-90	2	1	None.
9	Slow Flight-----	0	0	4	2,500-500	NOE	40	2	1	None.
10	Harmonization-----	20	0	0	750	Static	N/A	1	N/A	None.
11	Diving-----	20	0	0	1,200-500	1,500-500	40-110	2	1	None.
12	Diving to Running-----	30	0	0	1,200-500	1,500-L/L	40-110	2	1	Deflections left and right.
13	Running-----	40	0	0	1,200-500	NOE	60-90	3	1	Two deflections and one moving target.
14	Slow Flight-----	40	0	0	1,200-500	NOE	40	3	1	Two deflections and one moving target deflection.

Ammunition Expenditures: 4,500 7.62mm
150 40mm
14 2.75 in. HE/PD FFAR

¹ Low Level: Altitude between 50-300 ft absolute.

² Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-36. Period 7, Crew Annual Qualification Record Fire (Day)—UH-1 Helicopter

Exercise	Type of fire	Ammunition quantity			Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per run	No. of runs	Remarks
		40mm	7.62mm	2.75 in.						
1	Harmonization-----	0	500	0	600	Static	N/A	1 1/0	N/A	None.
2	Harmonization-----	0	0	2	1,200	600	60	0/1	1	None.
3	Diving-----	0	1,000	2	2,500-500	1,500-500	40-110	2/1	1	Flex tgts deflections.
4	Running-----	0	1,000	2	2,500-500	L/L	60-90	2/1	1	Flex tgts deflections.
5	Slow Flight-----	0	1,000	4	2,500-500	NOE ³	40	3/2	1	One flex tgt is moving tgt.
6	Running-----	0	1,000	4	2,500-500	NOE	60-90	3/2	1	One flex tgt is moving tgt, two stationary deflections.

Ammunition Expenditures: 4,500 7.62mm
14 2.75 in. HE/PD FFAR

¹ Flex/stowed targets.

² Low Level: Altitude between 50-300 ft absolute.

³ Nap-of-the-earth: Altitude below 50 ft absolute.

Table 13-37. Period 1, Annual Qualification Firing—Wire-Guided Missile (DX48 Simulator) (Day)

Exercise	Atmospheric condition	Type missile	Time of flight (seconds)	Speed azimuth	Speed elevation	No. of exercises	Remarks
1	Normal-----	Two	20	0	0	4	None.
2	Turbulence-----	Two	20	0	0	4	None.
3	Gusts-----	Two	20	0	0	4	Moving targets.
4	Turbulence-----	Two	20	15 Right	15 Down	4	None.
5	Turbulence-----	Two	20	10 Left	10 Up	4	None.
6	Turbulence-----	Two	20	15 Left	15 Down	4	None.
7	Turbulence-----	Two	20	20 Right	15 Up	4	Moving Targets.
8	Gusts-----	Two	20	20 Left	15 Up	4	Moving Targets
9	Turbulence-----	Two	20	5 Right	20 Up	4	None.
10	Turbulence-----	Two	20	25 Right	25 Down	4	None.

Note. It is recommended that this table be accomplished once monthly by each aviator qualified in the M22 subsystem.

Table 13-38. Period 2, Annual Qualification Firing—Wire-Guided Missile (Day)

Exercise	Type of fire	Ammunition quantity M22	Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per exercise	Remarks
1	Running.....	1	2,000-1,500	1,000	60-80	1	Inert.
2	Running.....	1	2,500-2,000	0-50	60-80	1	Inert.
3	Hovering.....	1	2,000-1,500	0-50	0-30	1	Inert.
4	Hovering.....	1	2,500-2,000	0-50	0-30	1	Inert.
5	Running.....	1	3,500-2,500	1,500	60-80	1	HEAT.

Ammunition expenditures: 4 ATM-22B (Inert).
1 AGM-22B (HEAT).

Table 13-39. Period 3, Annual Qualification Record Firing—Wire-Guided Missile (Night)

Exercise	Type of fire	Ammunition quantity M22	Target range (meters)	Flight altitude (feet)	Airspeed (knots)	Targets per exercise
1	Running.....	1	2,500-2,000	1,000	60-80	1

Ammunition expenditures: 1 ATM-22B (inert).
5 Rounds per student of artillery illumination.



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CHAPTER 14

UH-1D/H AND CH-47A DOOR GUNNER TRAINING

Section I. DOOR/RAMP MOUNTED ARMAMENT SUBSYSTEMS

14-1. General

Helicopter door/ramp guns provide armed helicopters with highly flexible fire to cover their own flanks and rear. For details on these armament subsystems, see TM 9-1005-262-15. Each of the methods below of mounting door/ramp guns has different capabilities and limitations.

14-2. M23 Armament Subsystem for UH-1D/H Helicopters

The M23 armament subsystem consists of two M60D 7.62mm machineguns, two mount assemblies, two ejection control bags, two ammunition boxes and chute assemblies, and two personnel safety harnesses. One machinegun is mounted in each cargo doorway of the helicopter (fig 14-1).

a. Weight. Subsystem weight without ammunition is 66.0 pounds; subsystem weight with ammunition (600 rounds) is 104.4 pounds.

b. Traverse. Forward and aft traverse limits are 1,546 mils.

c. Depression and Elevation Limits.

Gun direction	Depression (degrees)	Elevation (degrees)
Maximum forward	82	3½
Center	82	5
Maximum aft	78	6½

14-3. M24 Armament Subsystem for CH-47A Helicopters

The M24 armament subsystem is used on the CH-47A helicopters. It consists of two M60D 7.62mm machineguns, two mount assemblies, two ejection control bags, and two ammunition can assemblies. One machinegun is mounted to the cabin doorway on the right side of the helicopter (fig 14-2) and one to the escape hatch on the left side of the helicopter.

a. Weight. Subsystem weight without ammunition is 42.5 pounds; subsystem weight with ammunition (200 rounds) is 55.7 pounds.

b. Traverse. Left side total traversing capability

is 136°; right side total traversing capability is 146°.

c. Depression and Elevation Limits.

Gun direction	Left side		Right side	
	Depression (degrees)	Elevation (degrees)	Depression (degrees)	Elevation (degrees)
Maximum forward	24½	3	81	8
Center	68	5	73	8½
Maximum aft	67	7½	49	7

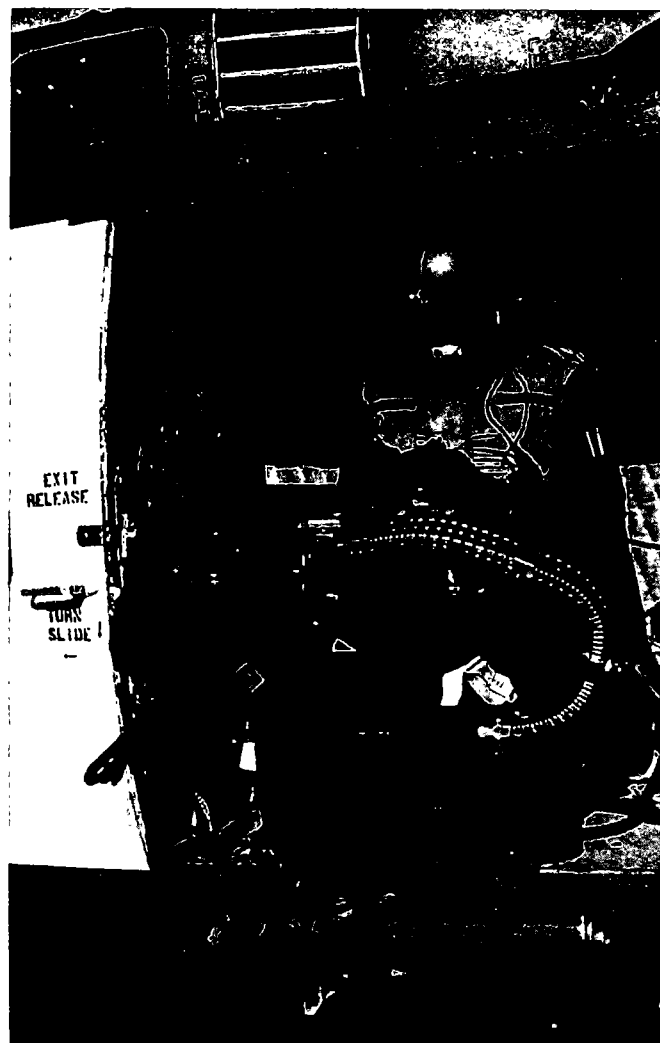
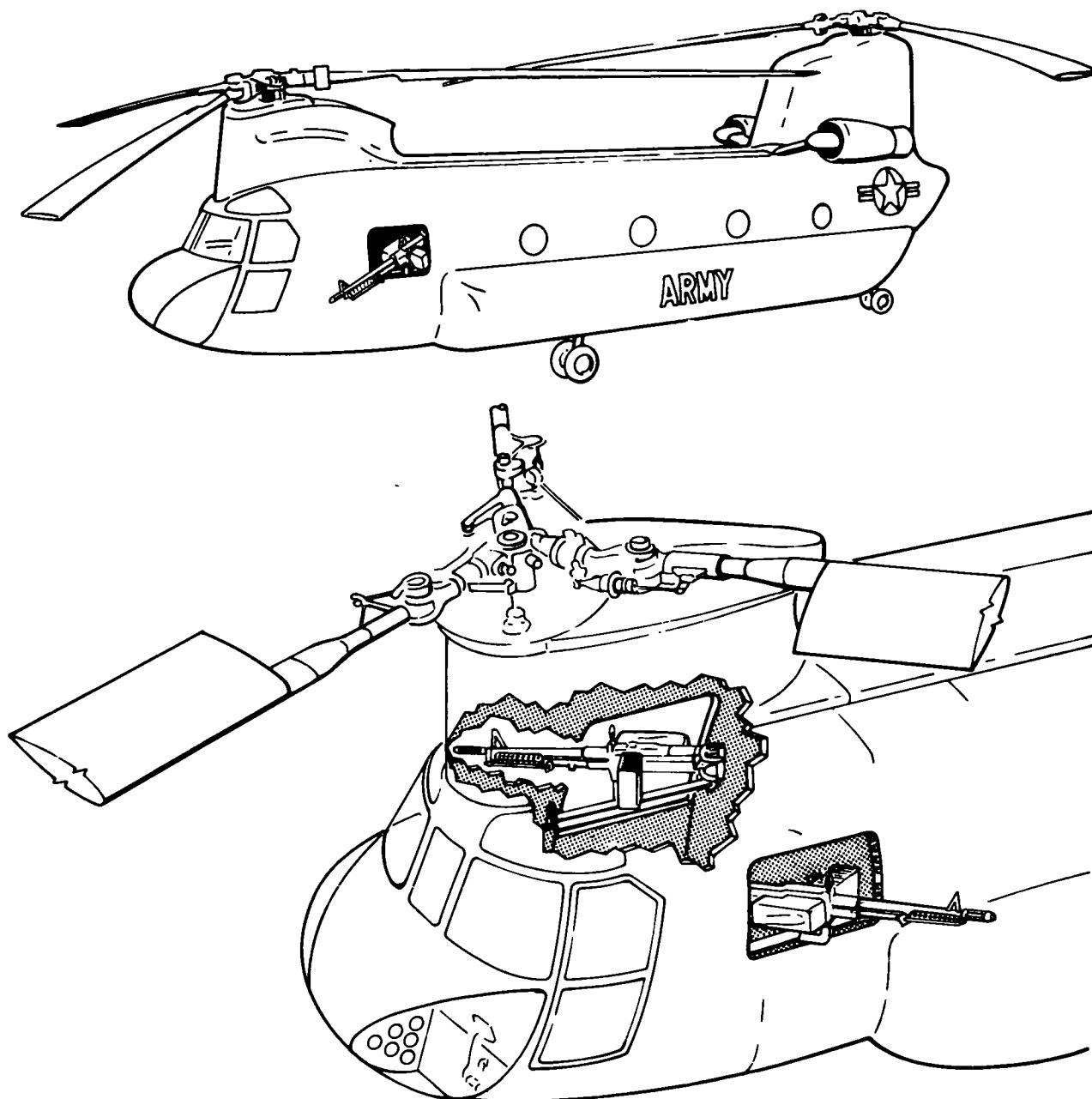


Figure 14-1. M23 armament subsystem.



WE 10371

Figure 14-2. M24 armament subsystem installed on CH-47A helicopter.

14-4. M41 Armament Subsystem for CH-47A Helicopters

The M41 armament subsystem is used on the CH-47A helicopter (fig 14-3). It consists of one M60D 7.62mm machinegun, one rear ramp mount assembly, one ammunition can assembly, and one ejection control bag. To provide rear fire, it is attached to the rear ramp of the helicopter.

a. Weight. Subsystem weight without ammunition is 41.8 pounds; subsystem weight with ammunition (200 rounds) is 55.0 pounds.

b. Traverse. Rear traverse capability is 1,671 mils.

c. Elevation. Rear elevation limit is 222 mils.

d. Depression. Rear depression limit is 1,227 mils.

14-5. M59 Armament Subsystem for UH-1D/H Helicopters

The M59 armament subsystem (fig 14-4 and 14-5) basically consists of the major components

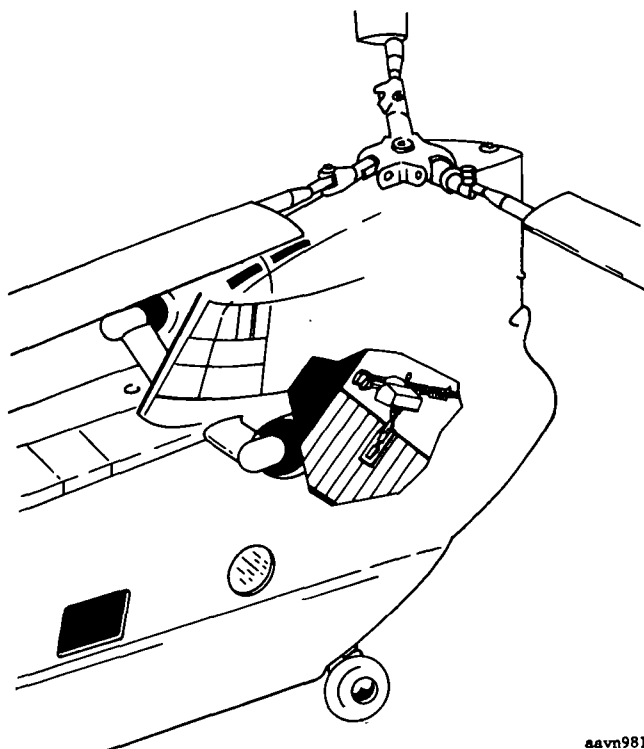


Figure 14-3. M41 armament subsystem installed on CH-47A helicopter.

of armament subsystem M23 (para 14-2) and the following major components: a modified caliber .50 XM213 machinegun, an ammunition tray assembly, a bag and frame assembly, a cradle assembly, a brass deflector assembly, a pintle post assembly, two armament subsystem M59 identification plates, and miscellaneous attaching hardware. One 7.62mm M60D machinegun, mounted on its pintle post assembly, is installed on one side of the helicopter; one caliber .50 XM213 machinegun, mounted on its pintle post assembly, is installed on the other side of the helicopter. The base tube assemblies are interchangeable, allowing for installation of M60D machinegun or XM213 machinegun on either side of the helicopter. For night operations, a firefly is used in con-

junction with the M59 armament subsystem to provide illumination. It is mounted to the immediate right or left of the subsystem (fig 14-4) and requires an additional crewmember to operate it. The guns are centrally positioned above the cargo deck of the helicopter and are manually operated by an operator/crew gunner. The guns can be elevated, depressed, or traversed within specified limits (*c* and *d* below). One forward beam, one aft beam, and one base tube assembly (parts of M23 subsystem mount assembly) are utilized when installing the caliber .50 XM213 machinegun portion of M59 armament subsystem.

a. Weight. M59 armament subsystem weight with—

- | | |
|--|-----------|
| (1) Two 7.62mm M60D machineguns without ammunition | 125 lb. |
| (2) Two 7.62mm M60D machineguns with ammunition | 188.3 lb. |
| (3) One 7.62mm M60D machineguns and one caliber .50 XM213 machinegun without ammunition | 216.7 lb. |
| (4) One 7.62mm M60D machinegun and one caliber .50 XM213 machinegun with ammunition (does not include can) | 276.8 lb. |

Note. One caliber .50 can containing 100 rounds of ammunition weighs 35 pounds.

b. Ammunition Capacities.

- | | |
|--|----------------|
| (1) Rate of fire—shots per minute | 700 ± 50 . |
| (2) With two 7.62mm M60D machineguns | 600 rounds. |
| (3) With one 7.62mm M60D machinegun and one caliber .50 XM213 machinegun | 400 rounds. |

c. Traverse. Forward and aft traverse limits are 1,564.5 mils.

d. Depression and Elevation Limits. Depression limit is 1,422.2 mils and elevation limit is 115.6 mils.

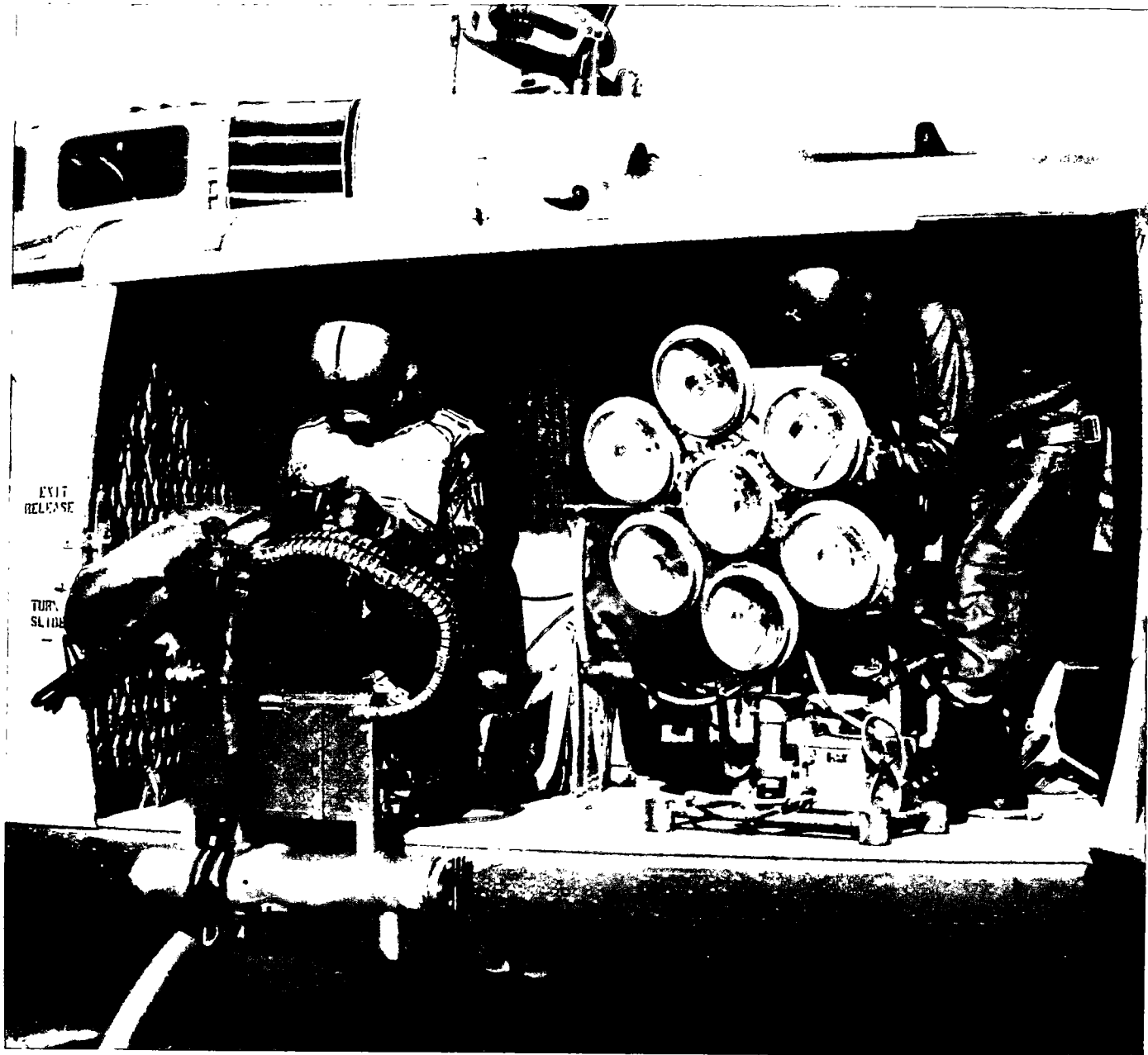


Figure 14-4. M60D machinegun portion of M59 armament subsystem with firefly.

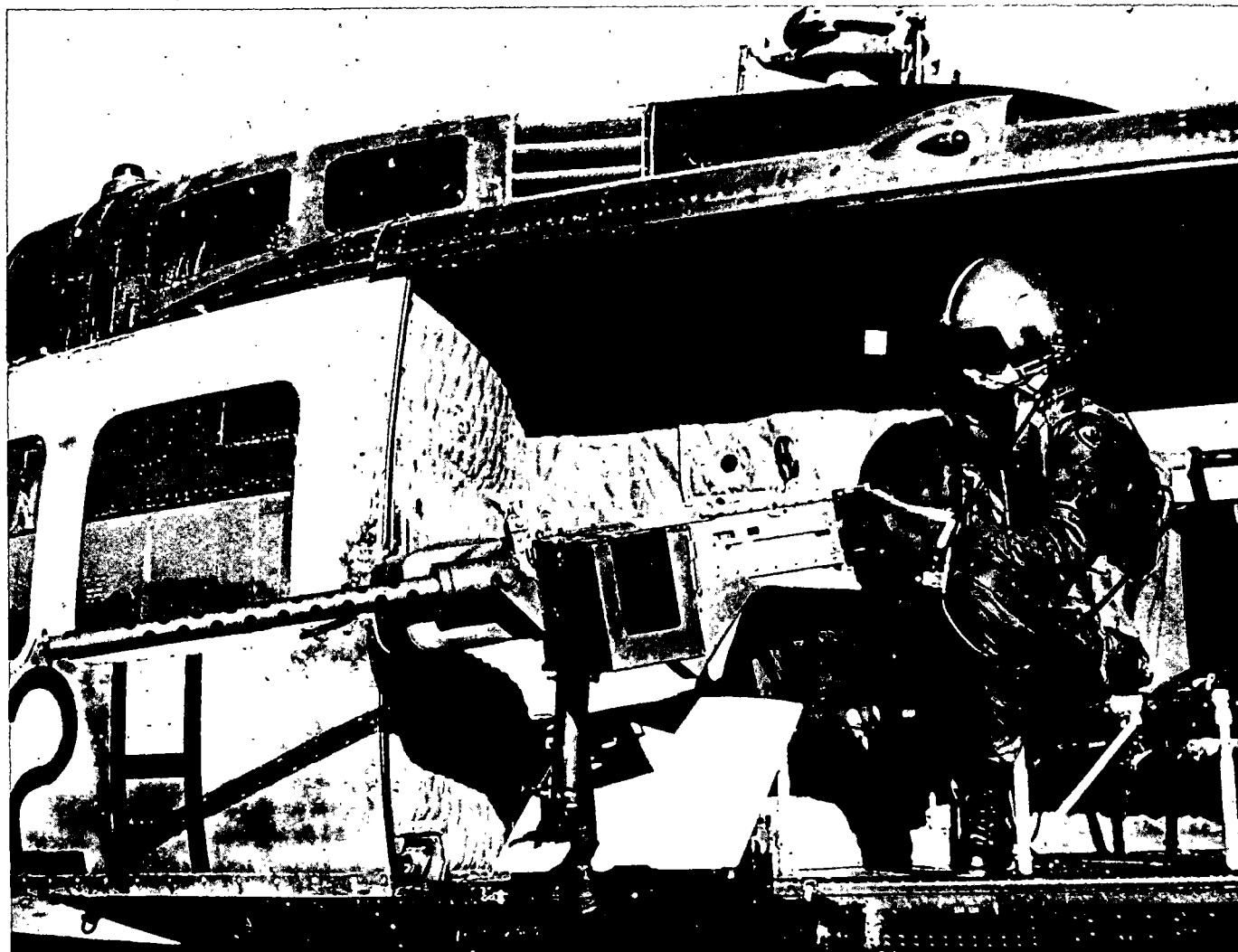


Figure 14-5. XM213 machinegun portion of M59 armament subsystem.

Section II. RECOMMENDED M60 MACHINEGUN GROUND RANGE FIRING AND FAMILIARIZATION STANDING OPERATING PROCEDURES

14-6. Purpose

To establish M60 machinegun range firing procedures and safety criteria for firing live ammunition from range towers.

14-7. Scope

This SOP provides specific procedures for conducting M60 machinegun firing exercises from range towers. It also includes guidance for student and assistant instructor behavior during these exercises.

14-8. References

- a. Local range safety regulations.
- b. AR 385-63.

14-9. Responsibilities of Personnel

a. *Range Officer in Charge (OIC)*. The range officer in charge is responsible for supervision of all range personnel and activities.

b. *Noncommissioned Officer in Charge (NCOIC)*. The NCOIC uses the range tower amplifier system to direct the actions of all gunners and assistant instructors during range firing; he also supervises all NCO on the range.

c. *Assistant instructors (AI)*. A qualified AI must be physically present in each firing tower during range firing and whenever student gunners are in the firing tower. The firing tower AI responsibility is to teach the gunner how to fire effectively. They will assist the OIC and NCOIC in carrying out the following training procedures:

(1) Safe handling of ammunition.

(2) Safing machineguns (removing barrels) when placing them in firing towers or removing them from firing towers.

(3) Correct procedures for loading and unloading ammunition and clearing machineguns.

(4) Fastening safety belts, removing brass and links from the floor of the range towers, and picking up the brass from under the towers after firing.

d. Ammunition NCO. The ammunition NCO will personally see that ammunition is properly placed and handled at all times. On order from the range tower, he will issue the ammunition to each student gunner and then will inspect the turned-in brass to verify that there are no live rounds present.

e. Equipment NCO. While the weapons are being cleaned, an AI designated by the NCOIC will be responsible for accounting for the equipment used on the firing line. He will report any missing equipment to the OIC.

14-10. Range Procedures

a. Tower Preparation. The NCOIC will assign a machinegun to the AI in each tower. Then the AI will remove the machinegun barrel before placing the machinegun in the tower where it is mounted on a fixed mount and the barrel is replaced. The AI will then secure the seat belts (if available) to the tower seats.

b. Introduction by OIC. All demonstration personnel will be at their posts before the class begins. The introduction will include standard range SOP, runaway gun, a firing demonstration, a clearing the weapon demonstration, a loading demonstration, range facilities, and the rotation system.

(1) *Safety regulations.*

(a) No running on the range.

(b) No smoking near ammunition.

(c) All weapons pointing downrange at all times.

(d) All gunners will fire at targets in front of their towers.

(e) No rounds will land outside the range markers downrange.

(f) Students will not stand in the tower except when assuming positions or when changing stations. When removing brass from the towers, all personnel will remain seated until the tower has been declared clear by the range control OIC or range tower NCOIC.

(g) All students will wear steel helmets.

(h) When a machinegun or ammunition is taken into or out of the firing tower, only one individual will be on the ladder steps at one time.

(i) When firing is being conducted or the firing line is not considered clear, no personnel will go forward of the base of the firing tower. To go forward of the base of the firing tower, the OIC must first have ordered firing to cease and each weapon to be cleared with a safety block inserted into the feed slot between the bolt and the chamber.

(2) *Firing demonstration.* Before the class begins, two AI will take the position of gunner and assistant gunner in a tower. This demonstration will consist of firing several 6- to 8-round bursts at stationary targets and about seven 6- to 8-round bursts at targets of opportunity. Bursts of 6 to 8 rounds are used to permit the gunner to gain maximum proficiency in adjusting fire with the number of rounds available. The remaining rounds in a 200-round belt will be fired to demonstrate incorrect techniques of fire (too-long or too-short bursts). These AI will remain in the tower until the entire class has completed range firing.

(3) *Loading demonstration.* The OIC will assemble the entire class in front of the bleachers for the loading demonstration. Every student should be positioned so that he can see the M60 machinegun loading demonstration.

(4) *Clearing the weapon demonstration.* The weapon clearing procedure is—

(a) Pull back the cocking lever.

(b) Place the safety on SAFE.

(c) Open the feed tray cover and lift up the feed tray.

(d) Check to make sure the chamber is empty.

(e) Close the feed tray cover.

Caution: Do not attempt to close the feed cover when the bolt is forward. If bolt is forward, pull the cocking lever handle to the rear. (For cocking lever handle (and bolt) to move to rear, safety must be in FIRE position.)

(f) Holding the cocking lever rearward, place the safety in the FIRE position. Still holding the cocking lever rearward, pull the trigger and allow the bolt to ride forward slowly.

Caution: When the gun is unloaded, do not allow the bolt to impact forward. In an unloaded gun, this action will damage the bolt, feed tray, and actuating cam roller.

(5) *Rotation system.* After the introduction, the NCOIC will arrange the students in four equal

ranks (orders). He will tell each concurrent station AI the number of students in each order. If any order reports to a station without the proper number of students, the AI on that station will report this to the NCOIC or OIC. The time allotted to each station should be about 50 minutes, after which the students take a 10-minute break and rotate to the next station.

14-11. Firing Techniques

a. Correct Sitting Position. When correctly seated, the gunner should be sitting on the very end of the appropriate* seat with his right (left) leg extending beyond the edge of the seat and pointing toward the target.

b. Adjusting Fire. The gunner should adjust his fire by observing bullet impact and the path of the tracers. Better effectiveness is also obtained by initially "walking" the strike of the bullets up to the target.

14-12. Conducting Range Firing

a. Hoisting Ammunition in Firing Tower. On command from the range NCOIC in the tower, the students who are firing will proceed from the safety line to the ammunition point to receive 200 rounds each of 7.62mm linked ammunition (4 rounds of ball to 1 round of tracer). With the AI aid, they will hoist the ammunition up to the tower.

b. Range Firing Procedures. One person at a time will climb up the steps to the firing platform. Then—

(1) One student (the gunner) will be seated at the rear of the machinegun and will secure his safety belt. The other student will take a seat on the right and to the rear of the tower.

(2) When the gunner, assistant gunner, and AI are properly positioned in each tower and the

* The seat chosen depends upon the side of the helicopter from which the door gunner will fire.

gunner is properly briefed, the AI will signal the range tower NCOIC that all is ready.

(3) When all firing tower AI have signaled ready, the range tower NCOIC will declare the firing line ready.

(4) On order from the NCOIC in the range tower, the gunners (assisted by the AI) will load the weapons.

(5) Each AI will notify the NCOIC in the range tower when each weapon is loaded and locked.

(6) On command from the range tower NCOIC, the gunners will commence firing at the proper targets of opportunity.

(7) Subsequent firing commands will be issued from the range tower NCOIC until all of the allotted ammunition has been expended.

(8) The gunner will clear the weapon. The weapon is considered clear when the bolt is forward, the cover is raised, all ammunition is removed from the weapon, and the safety is on SAFE position. After clearing the tower of brass and links, the AI will notify the NCOIC that the weapon is clear and that no loose brass or links are on the firing tower floor.

(9) The students will exchange places and steps (1) through (8) will be repeated.

(10) When firing has been completed and the firing tower has been declared clear by the NCOIC, both students will proceed to the bottom of the firing tower and assist the AI in lowering the cleared machinegun to the ground.

(11) All students will pick up the brass and links around the base of each firing tower under the supervision of the AI.

(12) The OIC will inspect all weapons that have been fired.

(13) There will be a critique of the class session.

(14) The OIC will check each student for brass and ammunition.

Section III. RECOMMENDED DOOR GUNNER AERIAL RANGE FIRING AND SAFETY STANDING OPERATING PROCEDURES

Note. This recommended SOP provides guidance for unit commanders and staff officers in preparing their own SOP. Each unit should develop range firing and safety SOP applicable to its special situation.

14-13. Purpose

To establish range procedures and safety criteria for door gunner aerial machinegun training.

14-14. Scope

This SOP provides checklists, safety procedures, and range operating procedures for conducting aerial door gunner machinegun range firing.

14-15. References

a. AR 385-63.

- b. Local range safety regulations.
- c. Local lesson plans for each armament subsystem.
- d. Technical manuals.

14-16. Definitions

- a. *Cook-Off*. The firing of a chambered round by heat from a hot barrel.
- b. *Hangfire*. A temporary failure or delay in the action of the primer in a cartridge.
- c. *Misfire*. A failure to fire.
- d. *Runaway Gun*. A gun which continues to fire after the trigger is released.
- e. *Weapon Cold*. The safety is on the SAFE position, preventing the weapon from firing. The weapon may or may not be loaded.
- f. *Weapon Hot*. Weapon is loaded with safety on FIRE position, ready to fire.

14-17. Range Facilities

Range flag(s), road guards, and range markers are as prescribed by local range regulations. Range facilities include the following:

- a. *Control Tower*. A control tower is located on each firing range. Each tower is equipped with UHF/FM radios, telephones, and an emergency warning device. Positive control over all range activities is exercised from the control tower.
- b. *Start-Firing Line and Cease-Firing Line Markers*. For locations of start-firing line and cease-firing line markers, see figures 14-12 and 14-13. The start-firing line on each range may consist of an asphalt or concrete pad, with parking spots marked for each helicopter. Approaches to and from the start-firing line will be kept clear of all vehicles, obstructions, and loose objects likely to interfere with helicopter operations.
- c. *Helicopter Parking Areas*. When available, helicopter parking areas are located adjacent to the start-firing line (b above) and are used by all helicopters not actively engaged in training. They may also be located on or near the start-firing line. Helicopter landing areas should be protected from dust to prevent visibility hazards and damage to helicopter components.
- d. *Vehicle Parking Areas*. Separate vehicle parking areas are located clear of all aircraft operations, whenever space is available. If separate parking areas are not available, parking areas will be located near control tower on the opposite

side from the firing line. Whenever possible, military vehicles will be unloaded and parked in designated areas away from aircraft operations. Civilian vehicles will be parked in designated areas completely clear of all aircraft and military vehicle operations.

e. *Ammunition Areas*. When applicable, ammunition areas are located in an area separate from other activities and adjacent to the helicopter parking and refueling area. Whenever possible, ammunition preparation and loading activities should be shielded from blowing dust and dirt.

f. Communications.

(1) Two-way radio communications will be established and maintained with all helicopters operating on the range.

(2) Telephone communication with range headquarters will be established and maintained at all times while the range is in operation. In an emergency, radio communication to another range tower that has telephone communication is acceptable until emergency repairs are completed.

14-18. Door Gunner Instructor Responsibilities

The instructor must—

- a. Be thoroughly familiar with range SOP, to include azimuth of range and specific firing sector limits.
- b. Insure that the student follows the techniques of fire outlined in the local lesson plan.
- c. Direct the student gunner in loading and unloading weapon as directed by the pilot.
- d. Be directly responsible for the status of the weapon (e.g., hot or cold) at all times.
- e. Clear the machinegun when firing impacts outside of prescribed impact area or when a weapon malfunction creates a safety hazard.
- f. At all times remain in a position where direct control and communication can be maintained with the student.
- g. In the event of communication failure between the pilot and instructor or instructor and student, discontinue firing and immediately clear the weapon.

14-19. Door Gunner Instructor Checklist

- a. Brief student gunner on range procedure and safety.
- b. Insure that firing is conducted only when—
 - (1) Cleared to fire by pilot.

(2) Weapon is pointed at target.

c. Monitor all aspects of range operation and advise the pilot of any unsafe conditions.

d. Insure at all times that no ammunition is loaded into weapon until pilot gives clearance to go "weapon hot."

e. Check that all ammunition has been cleared from the helicopter at the conclusion of the firing period.

f. At the conclusion of the firing, debrief student gunners on individual performance as prescribed in local lesson plans.

Section IV. DOOR GUNNER RANGE FIRING

14-20. Purpose

To qualify selected enlisted personnel in the techniques, skills, and duties of door gunners.

14-21. Recommended Program of Instruction

Training will be designed to meet the needs of

each unit and door gunner concerned. It should emphasize techniques involving target acquisition, helicopter door-mounted aerial machinegun firing, and related subjects. Training should include (but not be limited to) the subjects and time allocated below.

Subject	Hours	Type	Scope	References*
Introduction to UH-1 or CH-47 helicopter.	2	Conference and demonstration.	Description of UH-1 or CH-47 helicopter, including capabilities and airframe information.	TM 55-1520-209-10, TM 55-1520-210-10, TM 55-1520-218-10, TM 55-1520-219-10, and TM 55-1520-220-10.
Introduction to helicopter door gunnery.	1	Conference-----	Orientation conference covering the purpose of training.	Paragraphs 14-24 through 14-34; FM 23-67; and TM 9-1005-262-15.
Duties of the door gunner---	1	Conference-----	Duties of door gunners, before-mission procedures, target marking, handling of brass, safety procedures, and door gunner night firing including range estimation and target engagement.	Paragraphs 14-22 and 14-23, and 14-30 through 14-34.
Crewmember emergency----	1	Conference-----	Emergency landing procedures and destruction of subsystems to prevent enemy use.	TM 9-1005-262-15.
2.75-inch FFAR ammunition and safety.	1	Conference-----	Conference and demonstration covering 2.75-inch rocket; the various types of warheads; and proper loading, handling, and storage procedures.	Chapter 11 and TM 9-1340-201.
Introduction to M23-----	1	Conference-----	Conference to provide the student with a working knowledge of the M23 armament subsystem to include nomenclature, safety procedures, and operator-level maintenance.	TM 9-1005-262-15.
Assembly, disassembly, and nomenclature of M60D.	3	Demonstration and practical exercise.	Demonstration and practical exercise on the general and detailed disassembly, assembly, and nomenclature of M60D machinegun to include the M60D modification.	FM 23-67.

*Unless otherwise noted, references are to this publication.

Subject	Hours	Type	Scope	References*
Introduction to M59-----	1	Conference-----	Conference covering the general characteristics of the M59 armament subsystem to include all components, capabilities, and limitations.	TM 9-1005-304-12.
Assembly, disassembly, and nomenclature of XM213 .50 caliber machinegun.	4	Demonstration and practical exercise.	Demonstration and practical exercise on the general and detailed disassembly, assembly, and nomenclature of the XM213 .50 caliber machinegun.	TM 9-1005-304-12.
Head spacing and timing---	1	Demonstration and practical exercise.	Head spacing and timing-----	TM 9-1005-304-12.
Introduction to M21-----	1	Conference-----	Conference to provide the student with a working knowledge of the M21 armament subsystem to include nomenclature, safety, disassembly and assembly, lubrication, loading and unloading, and malfunction.	TM 9-1090-202-12.
Survival, evasion, and escape.	2	Conference-----	Conference on principles and techniques of evading the enemy and surviving in tropical jungle terrain.	FM 21-76.
Principles of air-to-ground machinegun fire.	1	Conference-----	Conference on principles and techniques of aerial machinegun fire from helicopters to include fixed and moving gun ballistic problems, employment of dispersion, and ring sight.	Chapter 2 and paragraphs 14-30 through 14-34.
M 60 machinegun familiarization firing.	5	Conference, demonstration, and practical exercise.	Introduction to M60 machinegun to include a practical exercise on firing the M60 from range towers and classes on machinegun assembly and disassembly, care and cleaning, and correcting stoppages and malfunctions.	Paragraphs 14-35a and 14-36. TM 9-1005-262-15; and FM 23-67.
Door gunner aerial machinegun firing range.	8	Practical exercise----	Practical exercise on door gunner air-to-ground machinegun firing techniques.	Paragraphs 14-37 and 14-38.
Introduction to M5.**-----	1	Conference-----	A conference covering the M5 armament subsystem.	Chapter 11; TM 9-1010-207-12.
Aerial illumination-----	1	Conference-----	Conference on the various means available to illuminate an area and necessary operating and safety procedures.	FM 20-60 and TM 9-1370-200.
Briefing on aircraft gas mask.	1	Conference-----	Conference on description, capabilities, limitations, nomenclature, and procedures for wearing the M24 aircraft gas mask.	TM 3-4240-219-14.
Emergency medical care----	2	Conference-----	Conference on principles and techniques of emergency medical care aboard aircraft.	FM 21-11 and 57-35; and TM 8-230.

*Unless otherwise noted, references are to this publication.

**This training required only when unit is equipped with this armament subsystem.

14-22. Routine Duties of the Door Gunner

Each door gunner must have a knowledge of his own weapons, and be familiar with the helicopter and its armament subsystem and with special situations and duties he might encounter while in flight. A door gunner—

a. Assists in preflight check. For preflight check procedures for UH-1B helicopters, see TM 55-1520-219-10; for UH-1C/M helicopters, see TM 55-1520-220-10; for UH-1D/H helicopters, see TM 55-1520-210-10; for CH-47A helicopters, see TM 55-1520-209-10. Before going on a mission, each door gunner must—

(1) Perform daily inspection of weapons subsystems as required by TM 9-1005-262-15 and other applicable operator's manuals, and immediately report any known maintenance deficiency which is beyond operator capability to organizational maintenance personnel for correction.

(2) Insure that prior to the mission, the proper amount and type of clean and serviceable ammunition (including right color and amount of smoke grenades) is on board helicopter.

(3) Check all armament subsystems for proper loading of ammunition.

b. Acts as observer.

(1) Since the pilot and copilot fly the helicopter, each door gunner must act as an observer from his side of the helicopter. The door gunner's primary area of observation is from 60° off the nose of the helicopter all the way to the rear. He observes for enemy activity and other aircraft. This observation includes hearing as well as seeing. Because of his position, each door gunner will often be able to hear fire that he could not observe visually. The door gunner's observation techniques will improve greatly with experience. For further details on observation techniques, see FM 1-80 and TM 1-380-series.

(2) Under field conditions and immediately before touchdown or takeoff, the door gunner also keeps a close watch for obstacles such as stumps, brush, or uneven ground.

c. Protects helicopter. Normally, door gunners provide neutralization fires when taking off, landing, and during target disengagement. Before firing, each door gunner must consider the location of friendly forces, location of other aircraft, and the ammunition available. The gunner's primary area of coverage is to the flanks and rear of the helicopter.

d. Marks targets. When required, each door gunner marks enemy fire by machinegun tracers

or smoke grenades. Smoke color for a mission is normally designated in the operation order or the SOI. However, smoke color may be designated just before throwing the smoke grenade. The spot report procedure for throwing a smoke grenade is—

(1) Select the correct color smoke grenade and throw it.

(2) Call "Smoke is out." If different color smokes are burning at the same time, give color of smoke.

(3) Report target, giving—

(a) Type of target.

(b) Distance from smoke to target.

(c) Either an azimuth heading from the smoke to the target (e.g., 090° from smoke) or an approximate directional reference using the clock system.

14-23. Emergency Landing Procedures

a. *Unit SOP.* The unit SOP should establish a drill for the crew to follow after an emergency landing in a hostile area.

(1) The drill should provide for immediately establishing security in the landing area.

(2) Radios and weapons should be removed from the helicopter to prevent enemy use. The unit SOP should designate the responsibility and priority for removing equipment.

b. *Door Gunner's Duties.* The door gunner must—

(1) Establish immediate security for the helicopter landing area.

(2) Know the procedures and techniques for removing radios and weapons from the helicopter.

(3) If capture is imminent, assist in destroying the helicopter armament subsystem and ammunition.

14-24. Fire Commands

Before departing on a mission, the helicopter commander orients his crew on the situation and the mission. His orientation will include the friendly situation, the enemy situation, rules of target engagement, marking of targets, possible target areas, fire commands, the location of emergency medical and survival equipment, and other available information essential to mission success. Fire commands that the helicopter commander may give each door gunner are—

a. *"On Order Gun."* This permits each door gunner to fire only upon the pilot's command.

b. *"Open Gun."* This permits each door gunner to fire when fired upon.

Section V. SAFETY

14-25. Brass

The M23 and M24 armament subsystems provide ejection control bags to eliminate problems with ejected brass when it falls to the floor. It may make footing hazardous or jam helicopter controls; if blown out of the helicopter, it can damage the tail rotor system.

14-26. Safety Harness

The door gunner should always wear a safety harness to permit him to move safely inside the helicopter.

14-27. Seat Belt

If the safety harness is not worn, the door gunner should remain safely strapped in his position by the door.

14-28. Body Armor

Many different types of body armor are now in use to provide chest and back protection. The situation will dictate when and what type of body armor is to be worn.

14-29. Other Flight Equipment

Flying gloves, frontpiece and backpiece, and SPH-4 helmet (equipped with a clear visor) should be worn during flight. The visor should be lowered during firing runs to protect the crewmembers' eyes from the back blast of the rockets as they are fired. To provide additional protection, the use of properly fitted V-51-R earplugs is strongly recommended. To minimize the hazards of rapid pressure changes during gunnery operations, a small (2mm) slit can be made in the end of each earplug with a sharp knife.

Section VI. AERIAL ADJUSTMENT OF FIRES

14-30. Using the M60D Machinegun Sight

The M60D machinegun has the original front blade sight and a ring sight.

a. Correction for Bullet Drop. Placing the horizontal cross hair and sight blade on line with the target automatically corrects for bullet drop at ranges up to 750 meters (fig. 14-6 and 14-7). The gunner must aim higher at ranges beyond 750 meters.

b. Correction for Lead Effect. To correct for lead effect, the gunner must align the target, front blade sight, and the appropriate point on the horizontal cross hair. However, this alignment is only approximate since the rapidly changing conditions will make accurate aiming impossible. When firing out of the right side of the helicopter, the gunner will use the right side of the appropriate ring; when firing out of the left side, he will use the left side of the appropriate ring. The gunner should first try to shoot slightly behind the target and then let the helicopter's forward flight carry his beaten zone across the target. For approximate sight corrections with the M60D sight for aiming behind the target at ranges up to 750 meters, see figures 14-6 and 14-7.

14-31. Firing the M60 Machinegun Without Using the Sight

The gunner uses tracers to fire long bursts and

spray the area up and down. However, occasionally he will be able to observe bullet strikes to help adjust his fire.

Caution: The machinegun has a tendency to climb when firing. The barrel must not be allowed to rise to an angle where other aircraft and/or the main rotor blade might be hit. If there is difficulty in controlling the weapon, the gunner should cease firing until he regains complete control.

14-32. Advantages of Using Tracers to Adjust Fire

Firing tracer ammunition permits the gunner to observe the trajectory of fire for a distance of 750 to 900 meters, thus permitting rapid adjustment of fire.

14-33. Disadvantages of Using Tracers to Adjust Fire

At long ranges, helicopter air-to-ground tracer fire may become deceptive. For example—

a. In figure 14-8, a gunner at point A fires a round at target T at 700 meters range but aims slightly high so that the tracer impacts at point I. By that time, the gunner has moved to point B and observes his apparent miss. Because of his change of position, he is led to believe that he has aimed high *and to the right*. This effect is called *observer shift*. It occurs primarily at great ranges

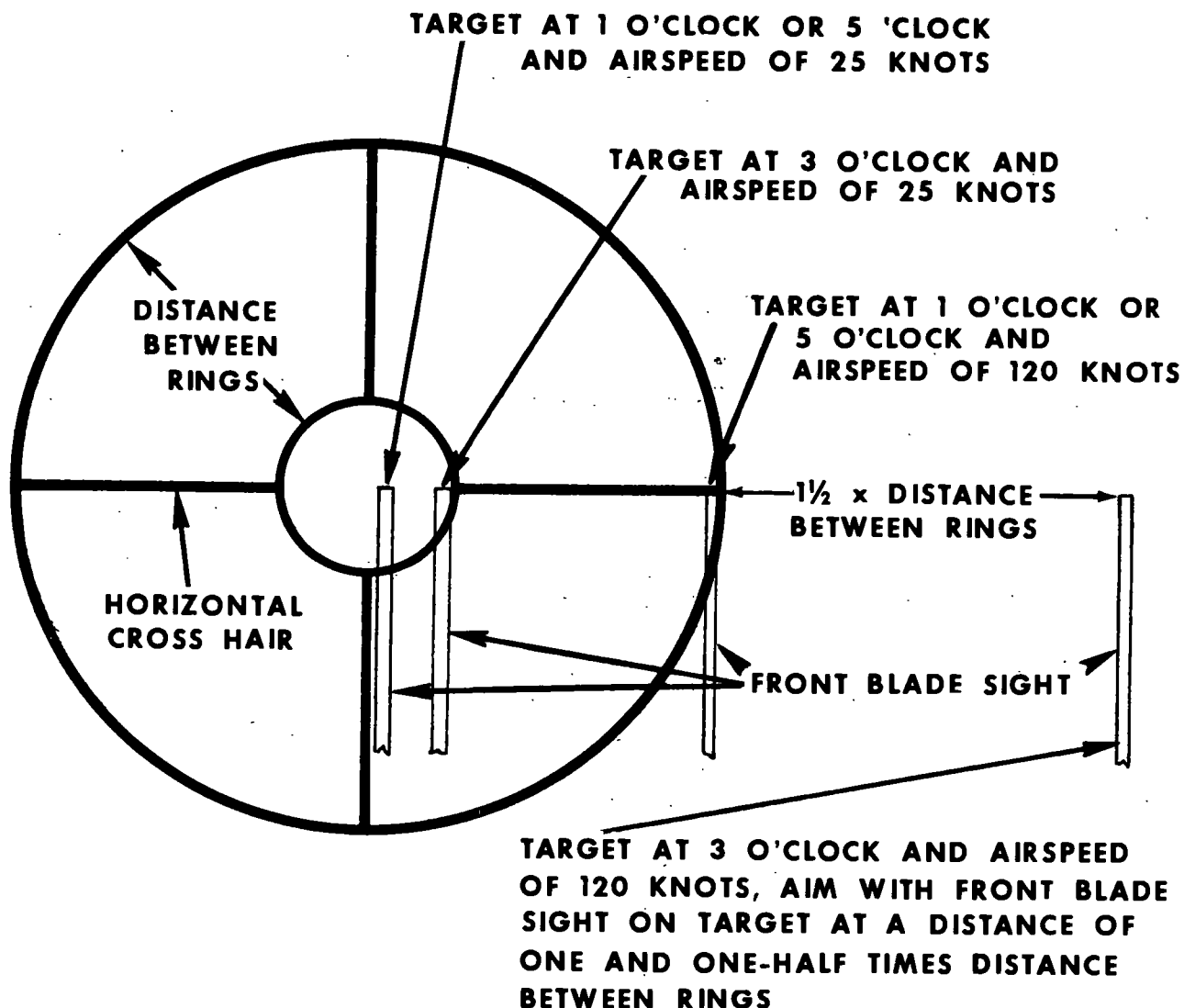


Figure 14-6. Sight corrections for right side of helicopter.

and is more pronounced with either increased aircraft speed or longer flight time of the bullet.

b. Observer shift is also deceptive when the gunner is firing at a target that is beyond tracer burnout range (fig 14-9). For example, the gunner with perfect aim fires a tracer from point A at target T. However, since target T happens to be beyond tracer burnout range, the tracer disappears at point D. At tracer burnout time the gunner has moved to point B. He sees the tracer disappear at point D and concludes (incorrectly) that he has aimed low and to the left; meanwhile, the bullet strikes the target.

14-34. Compensation for Effects of Observer Shift

It is possible for the gunner to compensate for the effects of observer shift; experienced gunners usually do this automatically. Awareness of the problem can greatly increase his ability to learn to correct for the deception. If the gunner can observe bullet strike, he can use that as a guide. This technique is especially valuable if the target is beyond tracer burnout range. When a usable sight is available, the gunner should use both the sight and tracers.

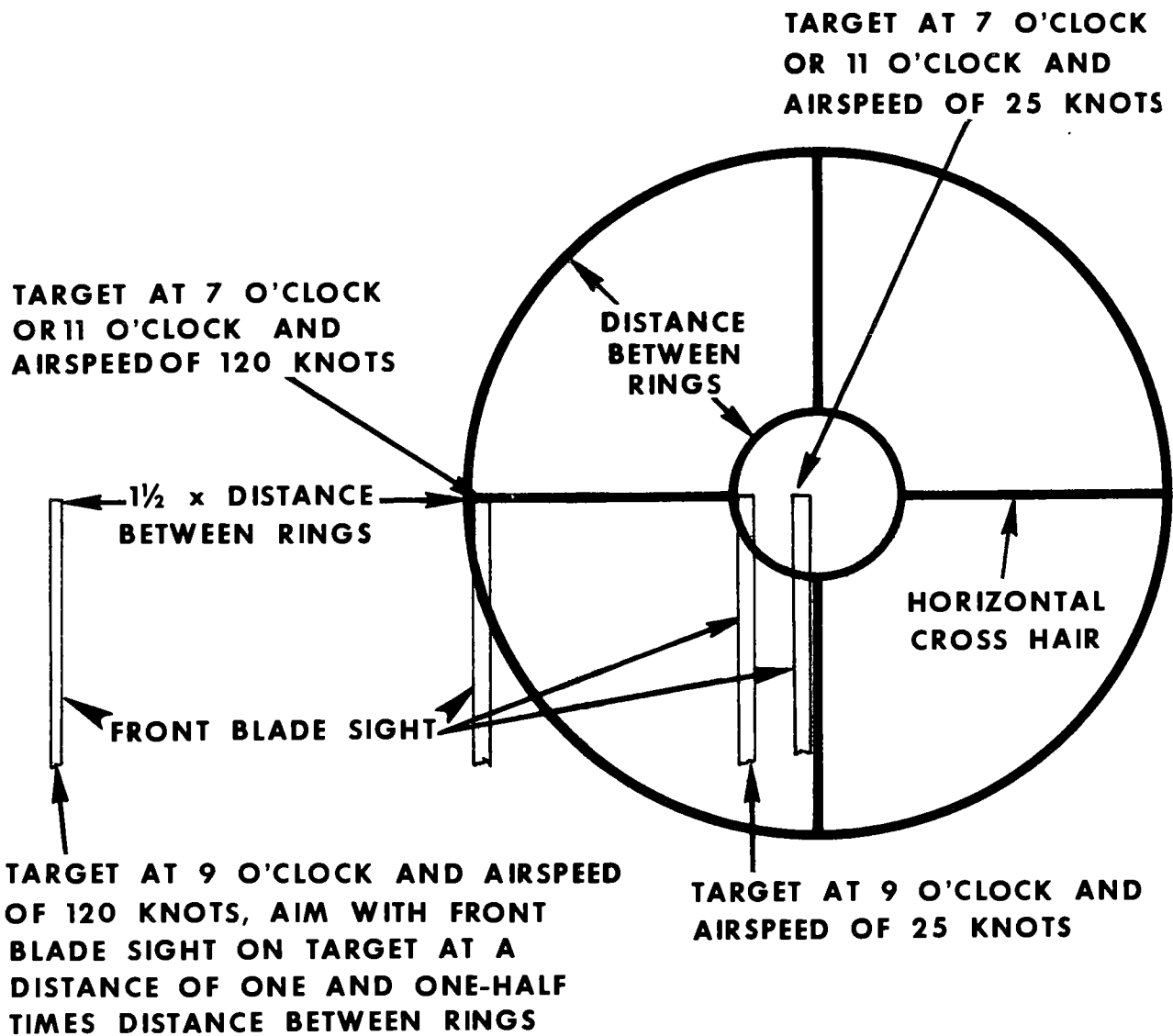


Figure 14-7. Sight corrections for left side of helicopter.

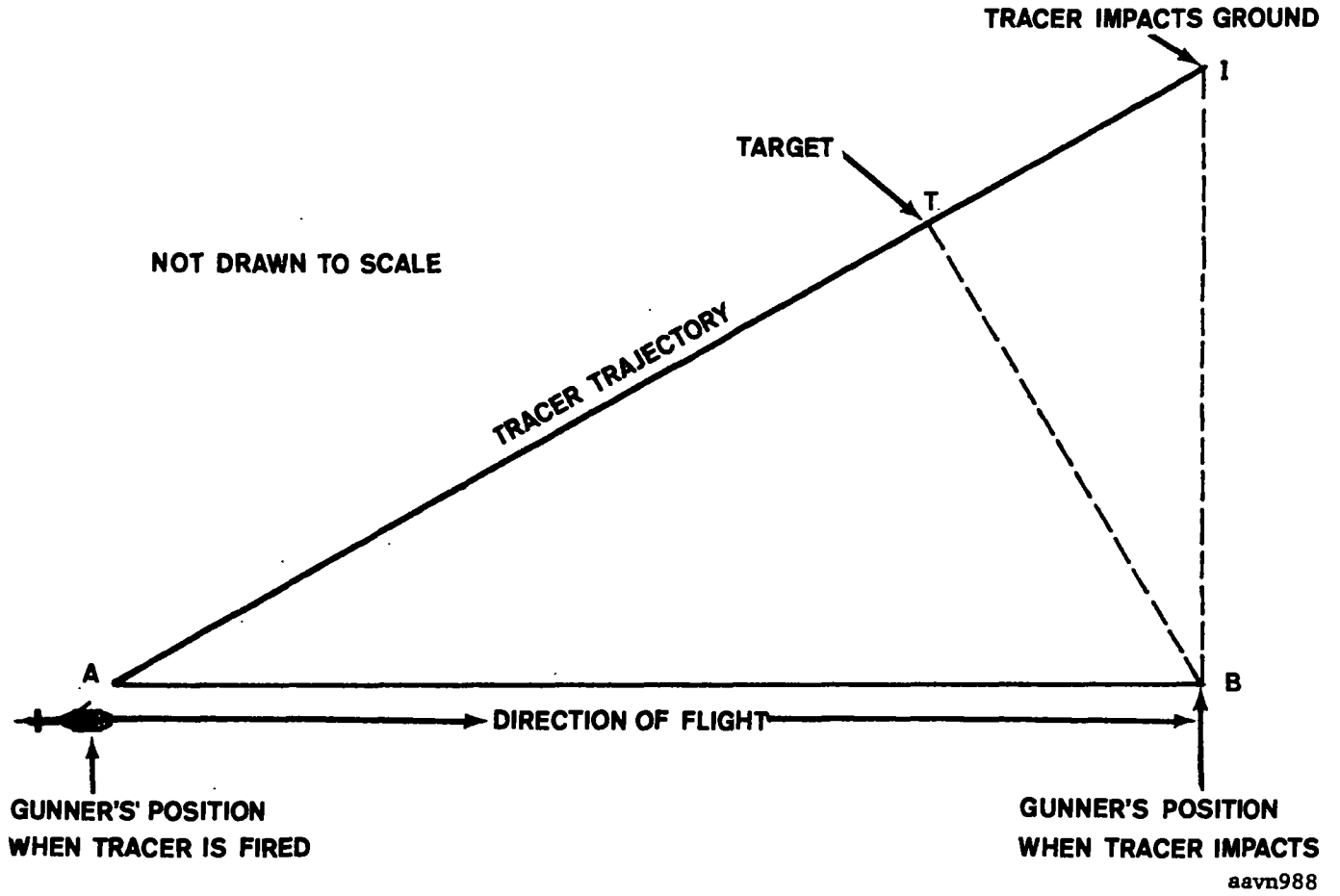


Figure 14-8. Observer shift effect before tracer burnout.

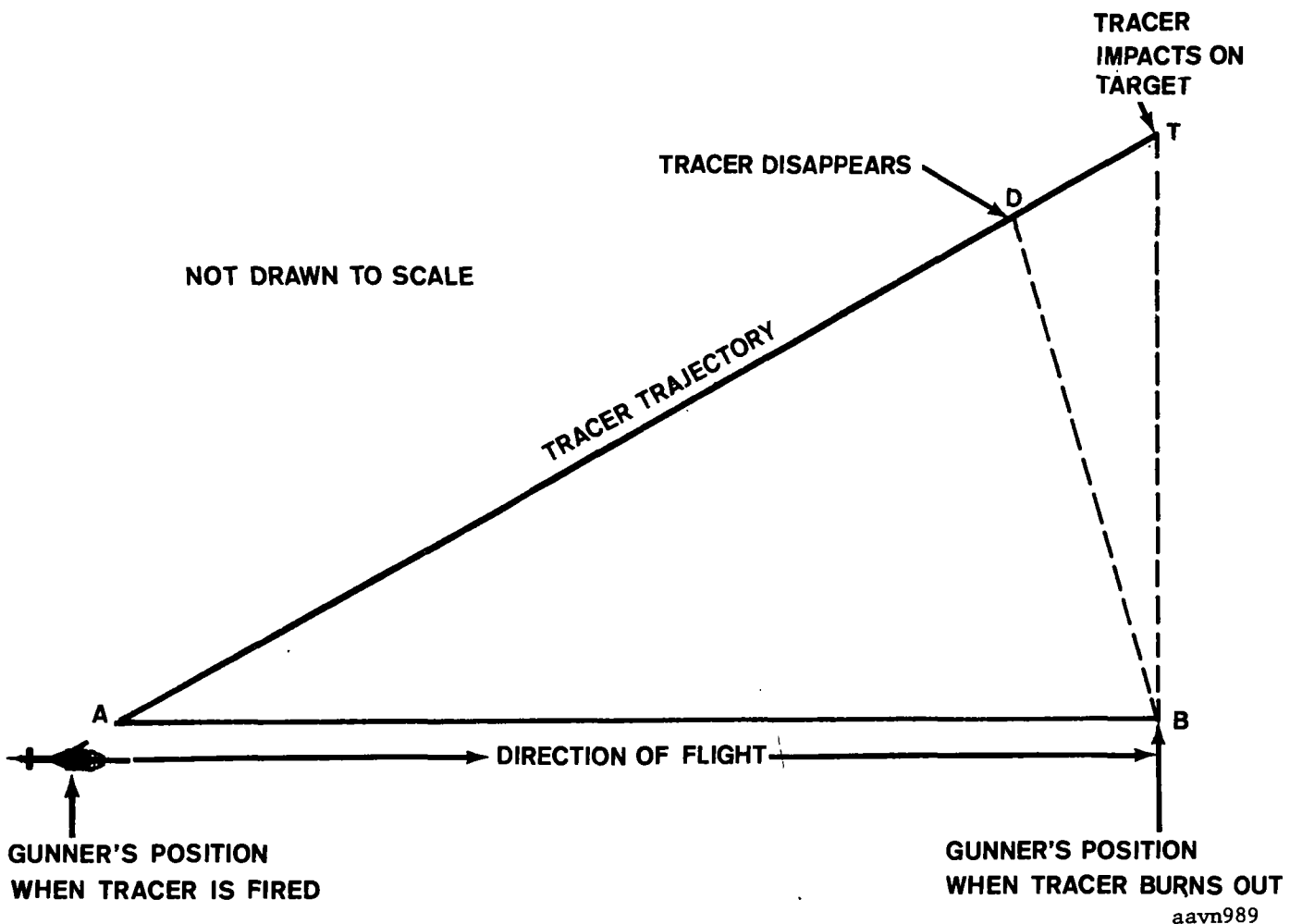


Figure 14-9. Observer shift effect after tracer burnout (apparent impact point).

Section VII. SUGGESTED DOOR GUNNER RANGES

14-35. Ranges for Door Gunner Training

a. Ground-Firing Range for M60 Machinegun Firing. A recommended range for door gunner machinegun ground firing is shown in figure 14-10. This range will meet the minimum requirement of familiarizing the door gunner with his weapon.

(1) *Suggested firing towers.* Firing towers (fig 14-11) permit door gunners to be taught the proper sitting position and the procedures for handling and firing machineguns. A fixed-mount machinegun is used. To simulate firing from either helicopter door, the door gunner and instructor may switch seats during firing exercises.

(2) *Targets.* Targets for target engagement are placed within and beyond M60 machinegun tracer burnout range. Target engagement beyond tracer burnout range will give the gunner practi-

cal experience in adjusting his fire by observing bullet strike/impact.

(a) *Silhouettes.* Silhouettes make very good training targets and add a degree of realism. Silhouettes should be placed in normal combat formations and at various ranges (fig 14-11).

(b) *Popup targets.* Popup targets are only used on ground-firing ranges. They increase the gunner's ability to acquire new targets at various ranges.

(c) *Target placement.* The contour of the available terrain will dictate target placement. During target placement, every effort should be made to provide realistic ranges.

(d) *Target engagement.* On ground-firing ranges, target engagement is limited to targets in front of and downrange from the firing point or tower.

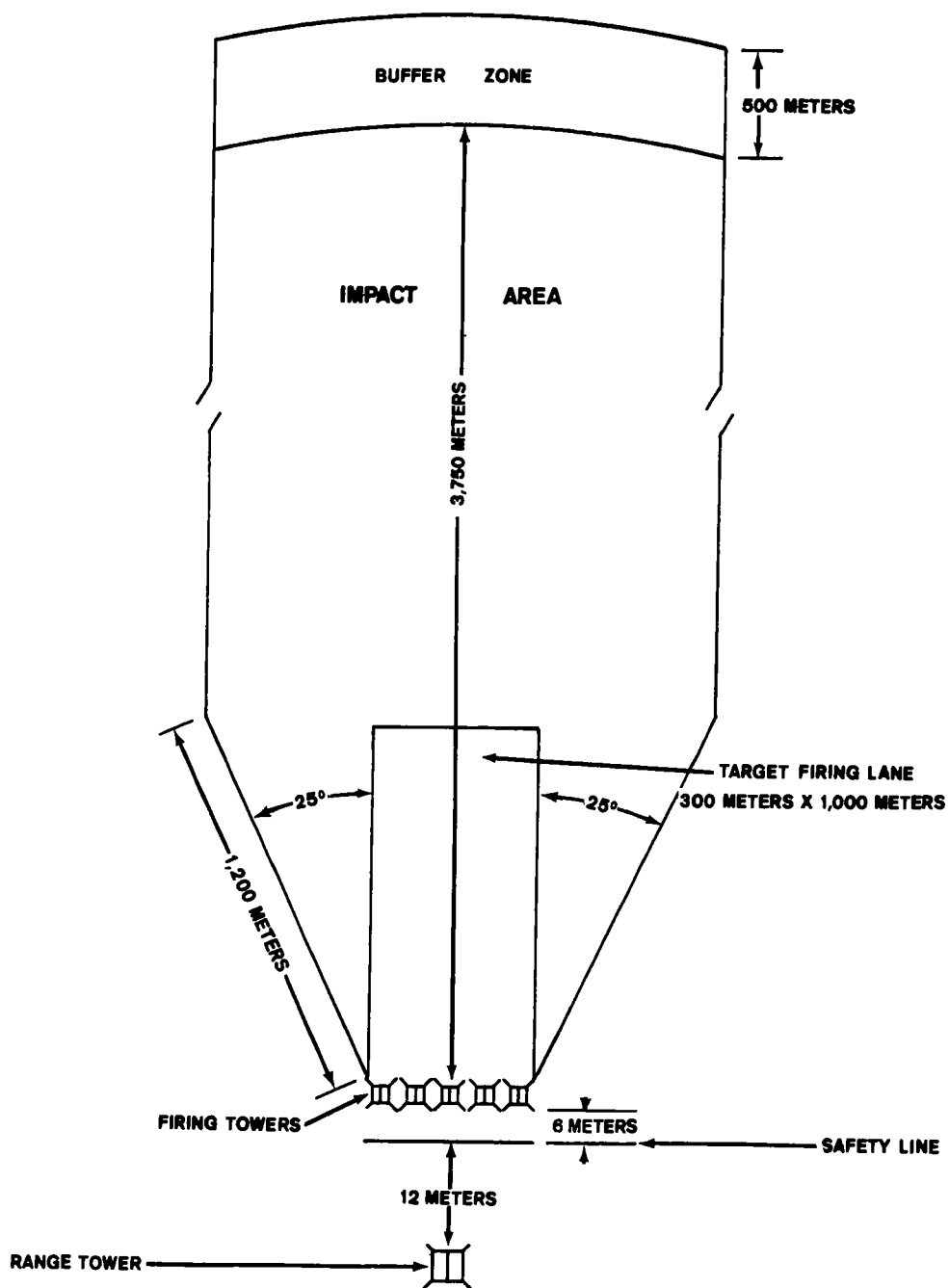


Figure 14-10. Recommended ground-firing machinegun range.

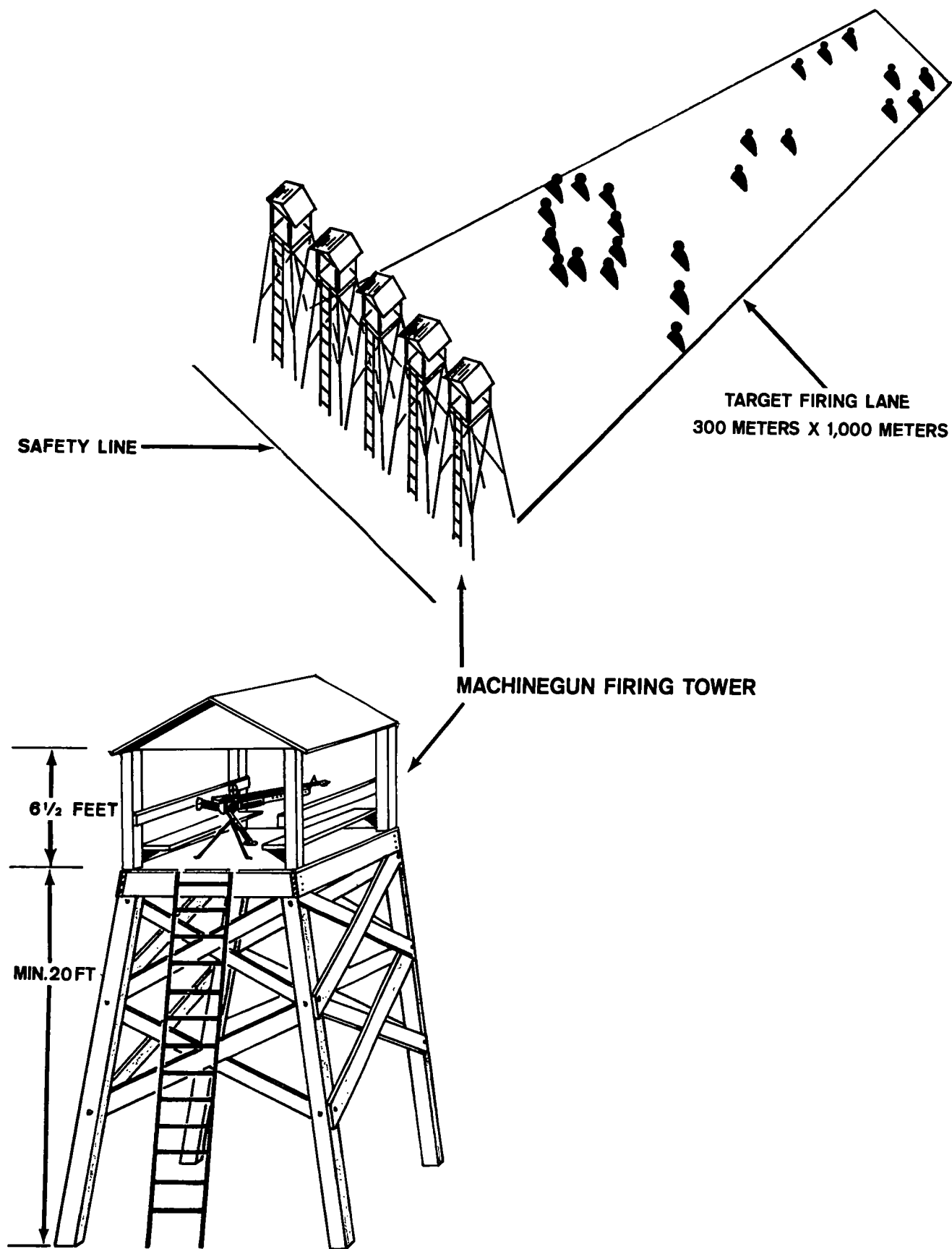


Figure 14-11. Suggested machinegun firing towers—placement and construction.

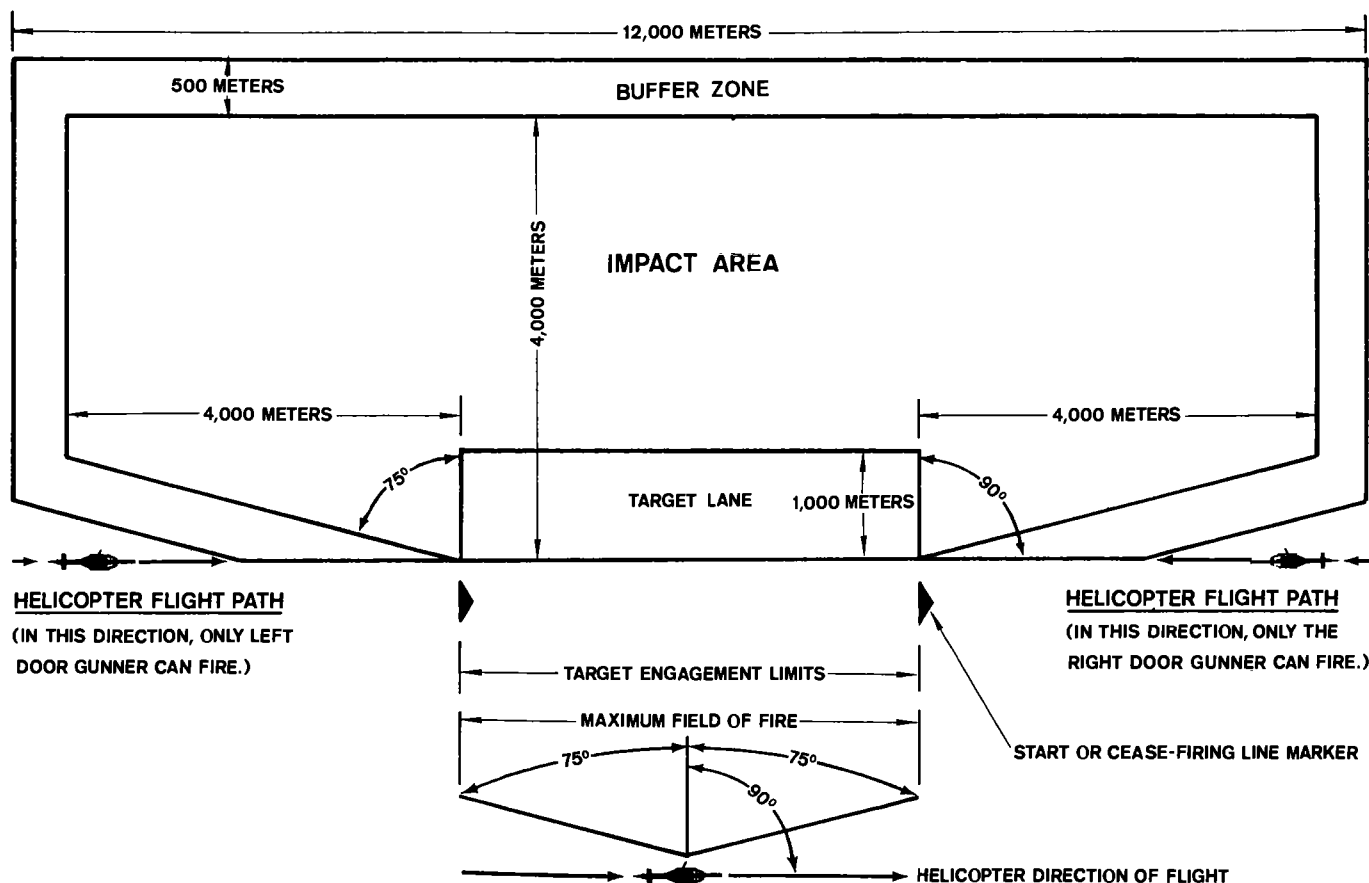


Figure 14-12. Suggested aerial door gunner firing range for firing from one helicopter door.

b. **Aerial Door Gunner Firing Ranges.** The purpose of aerial door gunnery training is to teach the door gunner how to make the proper lead correction when engaging a target from a helicopter in flight. For details on targets, see a(2) above. Target engagement on aerial fire ranges will be restricted to within the angular limits of impact areas. Suggested aerial door gunner firing ranges are as follows:

(1) *For firing from only one helicopter door.* Figure 14-12 shows a range suggested for door gunner firing from only one door, depending on which side of the helicopter is facing down the door gunner firing range.

(2) *For firing simultaneously from both helicopter doors.* Figure 14-13 shows a range suggested for both door gunners to fire simultaneously from each helicopter cargo door. When the helicopter turns to depart from this range, the door gunner on the outside of the turn may con-

tinue to engage targets as long as he shoots within the range impact area limits.

14-36. Ground Range Firing

All ground door gunner firing exercises must be conducted under the direction of a range control officer. Each gunner should fire about 200 rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer). The unit commander should determine the exact number of rounds required for training. While M60 machinegun firing is being conducted from towers on the range, M60 machinegun familiarization training can be conducted concurrently at three training stations.

14-37. Aerial Range Firing

All aerial door gunner firing must be conducted under the direction of a range control officer. This officer must be located either on the ground or in

a control tower that has complete visibility of all aerial firing. To control range firing, the range control officer must have radio communications with all helicopters using the range. The aerial range firing phase of instruction is designed to teach the door gunner the fundamental principles of air-to-ground machinegun fire. The door gunner should fire a sufficient number of rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer) to demonstrate the gun-

nery proficiency desired by the unit commander. He should be allowed to fire during all flight maneuvers, i.e., climbing, descending, shallow and steep turns, and nap-of-the-earth.

14-38. Scoring

Although no standard scoring system or qualification has been developed, scoring will be based on the instructor's judgment of the accuracy of fire on target.

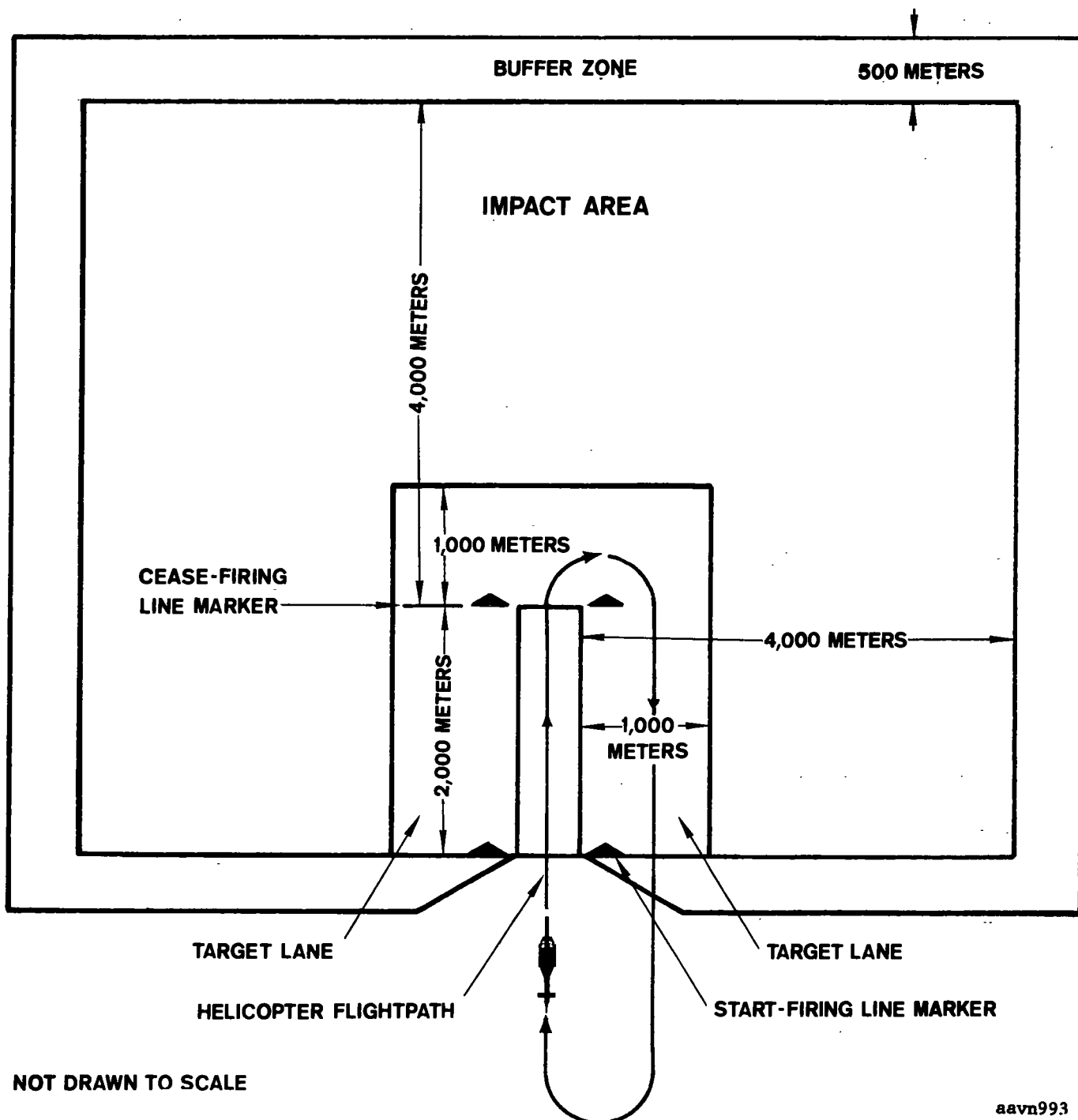


Figure 14-13. Suggested aerial door gunner firing range for simultaneous firing from both helicopter doors.

14-39. Ammunition Requirements

For aerial door gunner ammunition requirements, see table 14-1. This table is for guidance purposes

only and does not restrict flexibility exercised by local commanders. However, unit commanders must insure that ammunition expended will not exceed authorized allowance in CTA 23-100-6.

Table 14.1 Door Gunner Aerial Gunnery Ammunition Requirements

Helicopter	Armament subsystem	Machinegun	Ammunition, etc, ball, 7.62mm (No. of rounds per individual)					
			Initial qualification		Annual proficiency		Familiarisation	
			TR 4-1, MLB	TR, MLB	TR 4-1, MLB	TR, MLB	TR 4-1, MLB	TR, MLB
UH-1D/H	M23	M60D	500	1,500	500	500	500	500
CH-47A	M24	M60D	500	1,500	500	500	500	500
CH-47A	M41	M60D	500	1,500	500	500	500	500



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APPENDIX A

REFERENCES

A-1. Publication Indexes

Department of the Army Pamphlets of the 310-series should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

A-2. Army Regulations (AR)

95-series	(Aviation)
220-58	Organization and Training for Chemical, Biological, and Radiological (CBR) Defense.
310-series	(Military Publications)
310-25	Dictionary of United States Army Terms.
310-50	Authorized Abbreviations and Brevity Codes.
350-1	Army Training.
350-4	Qualification and Familiarization with Weapons and Weapon Systems.
380-5	Safeguarding Defense Information.
385-40	Accident Reporting and Records.
385-62	Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat.
385-63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
750-1	Army Materiel Maintenance Concepts and Policies.
750-51	Maintenance Assistance and Instruction Team (MAIT) Program.

A-3. Department of the Army Pamphlets (DA Pam)

108-1	Index of Army Motion Pictures and Related Audio-Visual Aids.
310-series	(Military Publications Indexes)
750-1	Commanders' Guide of Preventive Maintenance Indicators.

A-4. Field Manuals (FM)

1-15	Aviation Company, Battalion, Group, and Brigade.
1-80	Aerial Observer Techniques and Procedures.
1-100	Army Aviation Utilization.
1-105	Army Aviation Techniques and Procedures.
3-2	Tactical Employment of Riot Control Agent CS.
3-10/NWIP 36-2/ AFM 355-4/ FMFM 11-3	Employment of Chemical and Biological Agents.
5-15	Operational Aspects of Radiological Defense.
5-20	Field Fortifications.
5-25	Camouflage.
5-34	Explosives and Demolitions.
5-36	Engineer Field Data.
6-20-1	Route Reconnaissance and Classification.
6-20-2	Field Artillery Tactics.
6-40	Field Artillery Techniques.
	Field Artillery Cannon Gunnery.

6-102	Field Artillery Battalion, Aerial Field Artillery.
7-10	The Rifle Company, Platoons, and Squads.
7-20	The Infantry Battalions.
7-30	The Infantry Brigades.
9-6	Ammunition Service in the Theater of Operations.
10-8	Airdrop of Supplies and Equipment in the Theater of Operations.
17-1	Armor Operations.
17-12	Tank Gunnery.
17-36	Divisional Armored and Air Cavalry Units.
17-37	Air Cavalry Squadron.
20-60	Battlefield Illumination.
21-5	Military Training Management.
21-6	Techniques of Military Instruction.
21-11	First Aid for Soldiers.
21-26	Map Reading.
21-40	Chemical, Biological, Radiological, and Nuclear Defense.
21-60	Visual Signals.
21-76	Survival, Evasion, and Escape.
22-100	Military Leadership.
23-67	Machinegun 7.62mm, M60.
24-1	Tactical Communications Doctrine.
24-18	Field Radio Techniques.
29-23	Direct Support Maintenance Battalion (Nondivisional).
29-24	General Support Maintenance Battalion.
29-30-1	Division Maintenance Battalion.
29-36	Aircraft Maintenance Support.
30-5	Combat Intelligence.
31-16	Counter guerrilla Operations.
31-20	Special Forces Operational Techniques.
31-21	Special Forces Operations—US Army Doctrine.
31-50	Combat in Fortified and Built-Up Areas.
31-71	Northern Operations.
31-72	Mountain Operations.
(C) 32-5	Signal Security (SIGSEC) (U).
33-1	Psychological Operations—US Army Doctrine.
33-5	Psychological Operations—Techniques and Procedures.
57-35	Airmobile Operations.
100-26	The Air-Ground Operations System.
101-5	Staff Officers' Field Manual: Staff Organization and Procedure.

A-5. Training Circulars (TC)

1-16	Employment of Aircraft Flares From Army Aircraft.
1-34	Qualification Training in Army Aircraft.
3-16	Employment of Riot Control Agents, Flame, Smoke, Antiplant Agents, and Personnel Detectors in Counter guerrilla Operations.

A-6. Technical Manuals (TM)

1-215	Attitude Instrument Flying.
1-225	Navigation for Army Aviation.
1-250	Fixed Wing Flight.
1-260	Rotary Wing Flight.
1-380-series	(Aerial Observer Programmed Texts.)
3-210	Fallout Prediction.
3-4240-219-14	Operator's Organizational, DS, and GS Maintenance Manual: Mask, Chemical-Biological: Aircraft, Accessories.

- 5-330/AFM 86-3,
Vol 2
- 8-230
- 9-207/TO
36-1-40
- 9-1005-257-12
- 9-1005-262-15
- 9-1005-298-12
- 9-1005-299-12
- 9-1005-304-12
- 9-1005-304-20P
- 9-1010-207-12
- 9-1090-202-12
- 9-1090-202-35
- 9-1090-203-12
- 9-1090-204-12
- 9-1300-200
- 9-1300-206
- 9-1305-200/
TO 11A13-1-101
- 9-1330-208-25
- 9-1340-201
- Planning and Design of Roads, Airbases, and Heliports in the Theater of Operations.
- Army Medical Department Handbook of Basic Nursing.
- Operation and Maintenance of Ordnance Materiel in Cold Weather (0° to -65°F).
- Operator and Organizational Maintenance Manual: Armament Pod, Aircraft, 7.62-MM Machine Gun: M18 (1005-930-5597) Armament Pod, Aircraft, 7.62-MM Machine Gun: M18A1 (1005-832-7498).
- Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M23 (1005-907-0720) (Used on UH-1D Helicopters); Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M24 (1005-763-1404) (Used on CH-47A Helicopters); and Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Ramp Mounted, Lightweight, XM41 (1005-087-2046) (Used on CH-47A Helicopters).
- Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62-MM Machine Gun; High Rate, XM27E1 (1005-933-6242) (Used on OH-6A and OH-58A Helicopters).
- Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 20 Millimeter Automatic Gun: XM35 (1005-133-8193) (Used on AH-1G Helicopter).
- Operator's and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62-MM Machine Gun—Caliber .50 Machine Gun: Door Mounted, XM59 (1005-133-8224) (Used on UH-1D and UH-1H Helicopters).
- Organizational Maintenance Repair Parts and Special Tool Lists: Armament Subsystem, Helicopter, 7.62-MM Machinegun—Caliber .50 Machine Gun: Door Mounted, XM59 (1005-133-8224) (Used on UH-1D and UH-1H Helicopters).
- Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 40 Millimeter Grenade Launcher: M5 (Used on UH-1B Helicopters).
- Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun, 2.75-Inch Rocket Launcher: M21 (1090-823-5971) (Used on UH-1B and UH-1C Helicopters).
- Direct and General Support and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists) Armament Subsystem, Helicopter, 7.62-MM Machine Gun, 7.75-Inch Rocket Launcher: Twin, High Rate, XM21 (Used on UH-1B Helicopters).
- Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—40 Millimeter Grenade Launcher: XM28 (1090-933-6701) and Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—40 Millimeter Grenade Launcher: XM28E1 (1090-134-3071) (Used on AH-1G Helicopter).
- Operator and Organizational Maintenance Manual: Mount, Multiarmament, Helicopter: XM156 (1090-930-5018) (Used on UH-1B or UH-1C Helicopters).
- Ammunition, General.
- Care, Handling, Preservation, and Destruction of Ammunition.
- Small-Arms Ammunition.
- Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Dispenser, Grenade: Smoke, XM118.
- 2.75-Inch Folding-Fin Aircraft Rockets.

9-1370-200
TO 11A10-1-1
9-1400-461-20

55-1520-209-10
55-1520-210-10
55-1520-218-10
55-1520-219-10
55-1520-219-20

55-1520-220-10
55-1520-221-20

Military Pyrotechnics.

Organizational Maintenance Manual: Guided Missile Launcher, Helicopter
Armament Subsystem M22 (Used on UH-1B Helicopter).
Operator's Manual: Army Model CH-47A Helicopter.
Operator's Manual: Army Model UH-1D/H Helicopters.
Operator's Manual: Army Model UH-1A Helicopter.
Operator's Manual: Army Model UH-1B Helicopter.
Organizational Maintenance Manual: Army Model UH-1B Helicopter.
Operator's Manual: Army Model UH-1C/M Helicopter.
Operator's Manual: Army Model AH-1G Helicopter.
Organizational Maintenance Manual: Army Model AH-1G Helicopter.

A-7. Common Tables of Allowances (CTA)

23-100-6

Ammunition, Rockets, and Missiles for Unit Training—Active Army and
Reserve Components.

APPENDIX B

HELICOPTER ARMAMENT MODEL NUMBERS AND DEFINITIONS

B-1. Model Numbers Applicable to the Army Aircraft Armament Program

The prefix X indicates incomplete development or that standard A classification will not be awarded.

B-2. Helicopter Armament Subsystems

The following list of helicopter armament subsystems is a guide to all armament subsystems, past and present. While not all of the subsystems listed are applicable to attack helicopters, they are included here to provide all gunnery information applicable to attack helicopters.

XM1, XM1E1	Caliber .30 M37C machingun; twin gun (obsolete, used on OH-13).
M2	7.62mm M60C machinegun; twin gun (obsolete, used on OH-13 and OH-23).
XM3	2.75-inch rocket launcher, 48-tube (limited production, used on UH-1B/C only).
XM3E1	Improved XM3 2.75-inch rocket launcher, 53-tube. Subsystem launch tubes are 4 inches longer (obsolete, used on UH-1B/C only).
XM4	2.75-inch rocket launcher subsystem for the CH-34 (obsolete).
M5	One 40mm M75 grenade launcher nose-mounted on UH-1B/C (Std A—not in production).
M6	Quad 7.62mm M60C machinegun on UH-1B/C (formerly the XM-153 used on CH-21, all models of the M6 (M6E1/E2/E3) are obsolete; this item converted to M16 subsystem).
M6E1	Same as above, but on CH-34 (obsolete).
M6E2	Same as above, but on UH-1B/C at station 69 (obsolete).
M6E3 (M6)	Same as above, but on UH-1B/C at station 136 (obsolete).
XM7	7.62mm machinegun; twin gun (the 7.62mm subsystem on the OH-6A; development suspended; replaced by M27).
XM8	One 40mm grenade launcher (the M129 on the OH-6A; this item is developmental type only, not available for issue to using units).
XM10	Development cancelled.
XM11	(MICOM item) 6 each SS-11 missile installation on UH-1B.
M16	Quad 7.62mm M60C machingun; 2.75-inch, seven-tube rocket launcher (obsolete, used on UH-1B/C/M helicopters; M6 modified to incorporate rocket capability; this item converted to M21 subsystem).
XM17	2.75-inch rocket launcher 19-tube, reloadable, reusable, not repairable (used on UH-1B/C; two M159 rocket pods on Kellet pylons).
M21	7.62mm high rate M134 machinegun; 2.75-inch rocket launcher M158A1 (M16 modified by replacing four M60C machineguns with two M134 machineguns; Std A—not in production).
M22	Antitank guided missile subsystem for UH-1B/C/M using six AGM-22B missiles (formerly SS-11B1; Std A).
M23	One 7.62mm M60D machinegun; door pintle-mounted on each side of UH-1D/H (Std A—not in production).
M24	One 7.62mm M60D machinegun pintle-mounted on right door and one at left escape hatch on CH-47 (Std A—not in production).
XM26 (TOW)	TOW (Tube launched, Optically tracked, Wire guided) missile, for UH-1B/C/M (Research and engineering).

M27E-1	7.62mm machinegun—high rate; one M134 machinegun sidemounted on OH-6A/OH-58A (Std B—not in production).
M28A1	Two 7.62mm M134 machineguns; two 40mm M129, grenade launchers; or one M134 machinegun and one M129, turret-mounted on the nose of AH-1G (Std A—in production).
XM29	One 7.62mm M60D machinegun; pintle-mounted on UH-1B/C/M (cannot be used if external weapons subsystems are mounted). This item is similar to M23 subsystem except that it is for the UH-1B/C/M heli. copter (two prototypes built, task deferred).
XM30	Flexible dual installation of 30mm XM140 gun on UH-1B helicopter with 600 rounds ammunition per gun (Research and Development).
XM31	20mm automatic gun; one pod-mounted M24A1 gun on each side of UH-1B/C/M (Research and Development; two prototypes built).
XM32	Caliber .50 XM213 or 7.62mm machinegun mounted two on each side of CH-47A, or combination (Research and Development).
XM33	One caliber .50 XM213 machinegun or one 7.62mm M60D machinegun ramp-mounted in rear of CH-47A (Research and Development).
XM34	Dual 20mm M24A1 guns mounted one on each side of the CH-47A (Research and Development).
M35	20mm XM195 gun on AH-1G (Std B—not in production).
M41	One 7.62mm M60D machinegun; ramp-mounted on CH-47A (Std A—not in production).
XM50	Combination of M5 and XM21 on UH-1B/C. Includes new sight, control panel, and revised ammunition storage arrangement (Research and Development; inactive).
M59	M60D 7.62mm machinegun and/or M213 cal .50 machinegun, pintle mounted for side firing from UH-1D/H helicopter (Std B—not in production).
XM64	(Formerly TAT-102) chin turret for AH-1G with one 7.62mm GAU-2B/A machinegun and 8,000 rounds of ammunition fully flexible (obsolete).

B-3. Weapons Used in Helicopter Armament Subsystems

M60C	Machinegun, 7.62mm, electrically fired (limited production).
M60D	Machinegun, 7.62mm, spade grip with thumb triggers (Std A—in production).
M61A1	Gun, six-barrel, 20mm cannon, Gatling-type; electrically driven, Vulcan, barrel length 60 inches (Std A—in production).
M75	Launcher, grenade, 40mm (used on M5 subsystem; M75 modified to the M129 for application to the M28A1 subsystem; Std A—not in production).
M129	Launcher, grenade, 40mm (redesign of M75; this item is used on the XM8, M28A1, the XM51 nose turret for the AH-56A, XM94 Air Force subsystem, and the pintle mounted XM182 for the M113 armored personnel ground vehicle; Std A—not in production).
XM130	Gun, 20mm, automatic (redesign of M61 to provide gas drive; in production for Air Force).
XM133	Gun, 7.62mm, high cyclic rate machinegun w/gas drive.
M134	Gun, 7.62mm, high cyclic rate machinegun w/electric drive (used on M18, M21, M27, M28A1, XM53, and TAT-102).
XM140	Gun, 30mm, automatic, single barrel (used on XM30, XM52, and XM120 subsystems; Research and Development).
XM157	Launcher, 2.75-inch, FFAR, seven-tube reusable, not repairable (limited production).
M158A1	Launcher, 2.75-inch rocket, seven-tube reusable, repairable (replaces the XM157).
XM159	Launcher, 2.75-inch FFAR, 19-tube reusable, not repairable (limited production).

M195	Improved M61 gun (Std B—not in production).
XM196	M134 with modified housing for use in XM53 system (Research and Development).
XM197	Gun, 20mm, light weight, 3 barrel (limited production).
M200A1	Launcher, 2.75-inch FFAR, 19-tube reusable, repairable (replaces the XM159 on the AH-1G Cobra).
XM213	Gun, caliber .50 AN-M2 machinegun, flexible, with muzzle brake (Research and Development).

B-4. Multiarmament Helicopter Mount

XM156	Mount, multiarmament, used on UH-1B/C/M having M16 subsystem internal wiring (for XM157B, M158A, and XM159C 2.75-inch rocket launchers; limited production completed).
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B-5. Sights for Helicopter Armament Subsystems

M5	Sight, reflex, infinity, flexible, gunner's sight for M5 subsystem turret.
MK8	Fixed pilot's sight for rocket firing on UH-1, replaced by the M60 sight.
M28	Sight, reflex, infinity, flexible, gunner's sight for M28 subsystem turret.
XM58	Sight, antioscillation, flexible, for M22 subsystem (limited production).
XM60	Sight, infinity, flexible (pilot sight for M16 and M21 subsystems; limited production).
XM70	Sight, reflex, infinity, used on OH-6A/OH-58A helicopter for M27 and XM8 subsystems (flexible in elevation and depression only; limited production completed).
XM73	Sight, reflex, infinity, used on AH-1G helicopter for all wing stores and fixed forward firing turret weapons (limited production).

B-6. Aircraft Armament Pods

XM12	Air Force item, designated SUU-16A. Podded 20mm, M61 gun with linkless feed carrying 1,250 rounds (ram air turbine provided for high performance).
XM13	Podded installation of M75, 40mm grenade launcher, for fixed wing aircraft (carries 150 rounds of ammunition).
XM14	Air Force item, designated AUU12/A. Podded installation of caliber .50 M3 machinegun with 750 rounds of ammunition for fixed wing or UH-1B/C/M helicopters.
M18	Air Force item designated SUU-11A/A, 7.62mm GAU machinegun pod with 1,500 rounds of linkless ammunition for fixed wing aircraft.
M18A1	Air Force item designated SUU-11B/A. Increased torque and dual rate modification of M18 pod.
XM19	Dual 7.62mm M60C machinegun with 650 rounds of ammunition per gun; for fixed wing aircraft.
XM25	Air Force item designated SUU-23/A (XM130) gun; replaces M61 eliminating ram jet turbine.

B-7. Aircraft Dispensers

XM3	Dispenser, antipersonnel, mine (see XM47 mine dispersing subsystem).
XM9	Dispenser, bomb (modified SUU-7 for UH-1B/C/M, see SUU-14/A).
XM15	Dispenser for XM170 flares.
XM18	Army designation for Air Force SUU-14 (6 tube, 2.75-inch aircraft ejection).
XM19	Dispenser for MK45 aircraft flare with adapter.
XM25	Dispenser, bomb, aircraft (XM18 dispenser and XM144 frag bombs).
XM27	Dispenser, grenade, aircraft (XM18 dispenser and XM54 grenade).
XM47	Mine dispersing subsystem (XM3 dispenser and XM27 mines).

XM118

Smoke grenade dispenser for AH-1G.

B-8. Canisters

XM15

50-pound cluster of eight modules of XM16 CS canisters.

XM165

130-pound cluster of two XM15 CS canisters.

APPENDIX C

HELICOPTER ARMAMENT DATA

Section I. TYPES OF AMMUNITION

C-1. General

Aircraft weapons subsystems require several types of standard and nonstandard munitions. For details concerning the munitions required for each subsystem, see the appropriate TM 9-series. This appendix lists munitions required for helicopter armament subsystems.

C-2. 7.62mm Ammunition

a. Commonly used 7.62mm (NATO) helicopter machinegun subsystem ammunition includes—

- (1) M59 or M80—ball.
- (2) M61—armor piercing (AP).
- (3) M62—tracer.
- (4) M160—frangible round.

b. Two additional types of 7.62mm ammunition not normally used in machinegun subsystems are—

- (1) M63—dummy.
- (2) M60—high-pressure, test.

C-3. Caliber .50 Ammunition

a. Numerous types of caliber .50 ammunition are used in helicopter armament subsystems including—

- (1) M2—armor piercing.
- (2) M8—armor piercing, incendiary.
- (3) T49—armor piercing, incendiary.
- (4) M20—armor piercing, incendiary, tracer.
- (5) M33—ball.
- (6) M1—incendiary.
- (7) M23—incendiary.
- (8) M1—tracer.
- (9) M10—tracer.
- (10) M17—tracer.
- (11) M21—tracer.

b. Other Caliber .50 ammunition available for training and testing includes—

- (1) M1—blank.
- (2) M2—dummy.
- (3) M1—high-pressure, test.

C-4. 20mm Ammunition

Different types of 20mm guns are listed below with their ammunition type requirements.

a. *M24A1, gun, 20mm, Automatic, Single-Barrel.*

- (1) M95—armor piercing, tracer.
- (2) M58—high explosive, incendiary.
- (3) M97A1—high explosive, incendiary.
- (4) M96—incendiary.
- (5) M99—target practice.
- (6) M18—dummy.

b. *Automatic 20mm Six-Barrel Gun: M195—Electric Drive; XM130—Gas Drive.*

- (1) T221E3—armor piercing, incendiary.
- (2) M55A1—ball.
- (3) M56A1 (T198E1)—high explosive, incendiary.
- (4) M51 (T228)—dummy.
- (5) M54 (T156)—high-pressure, test.
- (6) Tracer ammunition.

C-5. 30mm Ammunition

Ammunition for the XM140, gun 30mm, automatic (WECOM-30), single-barrel includes the XM552 cartridge, high explosive, dual purpose and the XM639 (inert).

C-6. 40mm Ammunition

a. The 40mm ammunition used in the M75 or M129 launchers includes—

- (1) M383—cartridge, high explosive.
- (2) M384—cartridge, high explosive.
- (3) M385—cartridge, practice.
- (4) M430—cartridge, high explosive, dual purpose.
- (5) XM677—cartridge, high explosive, tracer.
- (6) XM683—cartridge, high explosive, extended range.
- (7) XM684—cartridge, high explosive, w/proximity fuze.

b. All 40mm cartridges are fixed type ammunition and are ready for use as issued. All rounds except the XM684 cartridge utilize point detonating (PD) fuzes which allow functioning at impact angles from 90° to 30° (low graze).

C-7. 2.75-Inch Folding Fin Aircraft Rockets (FFAR)

a. Launchers for the 2.75-inch FFAR are—

- (1) M158A1—seven tube, reloadable, reusable, repairable.
- (2) M200A1—19 tube, reloadable, reusable, repairable.

b. Warheads for the 2.75-inch FFAR are—

- (1) MK1—high explosive, 6 lb.
- (2) MK5—HEAT.
- (3) MK67—white phosphorous, 6 lb.
- (4) M151—high explosive, 10 lb.
- (5) XM152—high explosive, white phosphorous, red marker, 6 lb.
- (6) XM153—high explosive, white phosphorous, yellow marker, 6 lb.
- (7) M156—white phosphorous, 10 lb.
- (8) XM157—smoke, red, 10 lb.
- (9) XM158—smoke, yellow, 10 lb.
- (10) M229—high explosive, 17 lb.
- (11) M230—practice, 10 lb.
- (12) XM232—practice, spotting, 10 lb.
- (13) XM247—dual-purpose (antitank/anti-personnel), 10 lb.
- (14) WDU 4 A/A—flechette, 10 lb.

c. Fuzes for the 2.75-inch FFAR include—

- (1) M423—PD (graze sensitive).
- (2) XM427—redesign of M423 to allow delayed arming.
- (3) M429—proximity.
- (4) M435—dummy.
- (5) M440—dual purpose impact (superquick or delay) bunker defeating.

d. Types of 2.75-inch FFAR motors are—

- (1) MK4—(unscarfed) for high performance delivery.
- (2) MK40—(scarfed) for low speed aircraft delivery.

C-8. M22 Missile Subsystem Ammunition

Ammunition for the M22 subsystem includes an AGM-22B guided missile with high explosive antitank warhead, an ATM-22B guided missile with inert warhead filled with a marking powder, and an ATM guided missile with completely inert warhead.

C-9. Munitions for Special Attack Helicopter Missions

The munitions listed below are not normally used in attack or limited attack helicopter roles and missions. However, they could be used on attack helicopters during special missions.

- a. XM52—smoke generator, exhaust stack mounted.
- b. XM147—bomb, fragmentation (XM9).
- c. XM142—bomb, antitank (XM9).
- d. XM144—bomb, fragmentation (XM25).
- e. XM920E2—bomb, fuze and burster, CS in 55-gallon drum.
- f. MK24—flare, aircraft parachute.
- g. MK45—improved flare, aircraft parachute.
- h. E39R1—smoke tank.
- i. E158—50 lb. CS canister cluster.
- j. E159—130 lb. CS canister cluster (two E/58 with strongback).
- k. Helicopter trap weapon—to sanitize landing zones.
- l. Fuel—air explosive, to sanitize landing zones.

Section II. HELICOPTER ARMAMENT SUBSYSTEM DATA

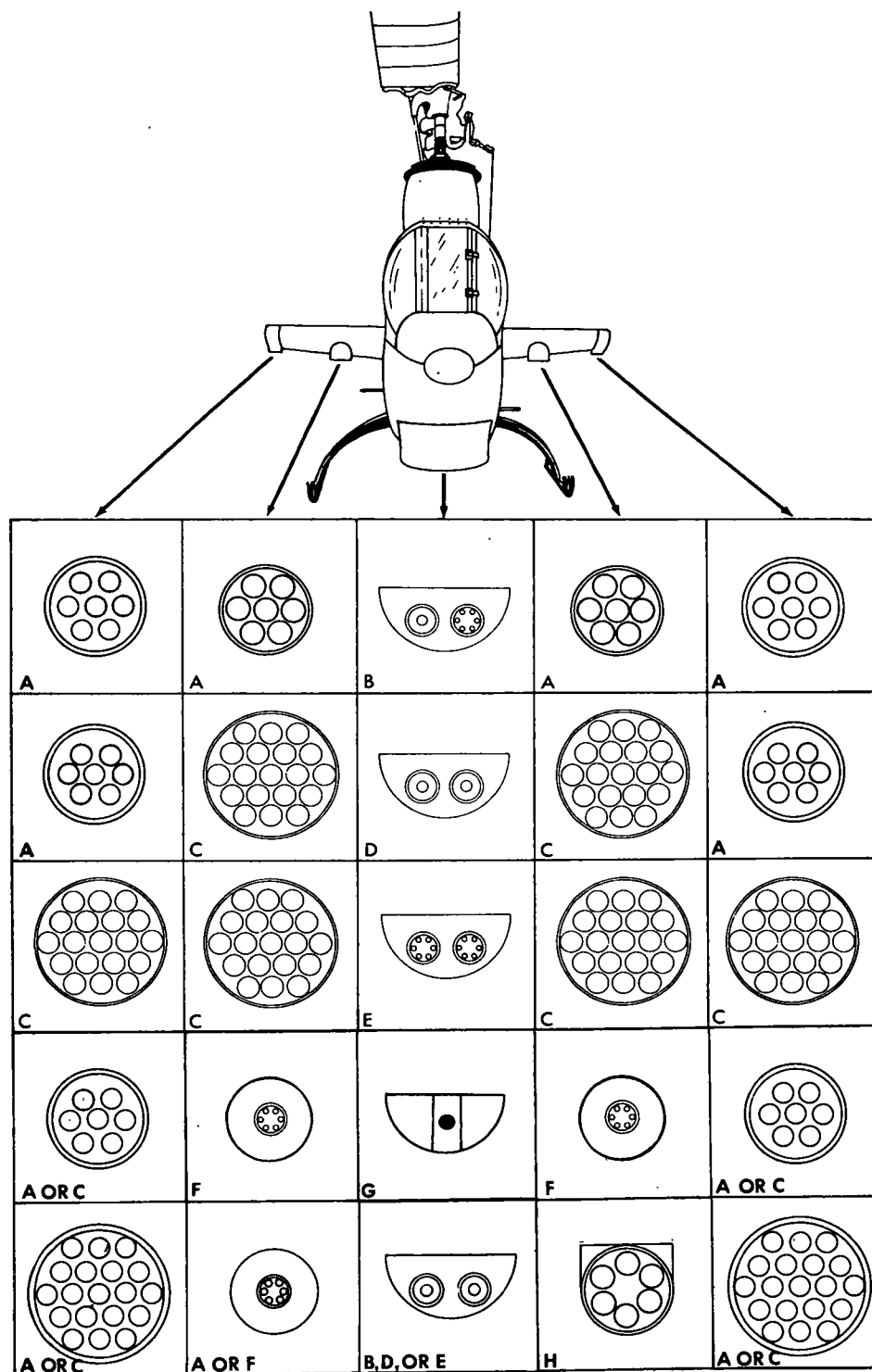
C-10. Armament Subsystem Performance

Various armament configurations for the AH-1G and UH-1B/C/M attack helicopters are shown in figures C-1 and C-2. All possible combinations are not shown. For AH-1G armament subsystem

performance data, see table C-1. For AH-1G and UH-1B/C/M performance data, see table C-2.

C-11. Attack Helicopter Performance Data

For attack helicopter performance data utilizing various ammunition loads, see table C-3.



A M158A1: SEVEN-TUBE, 2.75-INCH ROCKET LAUNCHER.

B M28A1 SUBSYSTEM: 7.62MM HIGH RATE AUTOMATIC GUN AND 40MM GRENADE LAUNCHER.

C M200A1: 19-TUBE, 2.75-INCH ROCKET LAUNCHER.

D M28A1 SUBSYSTEM: TWO 40MM GRENADE LAUNCHERS.

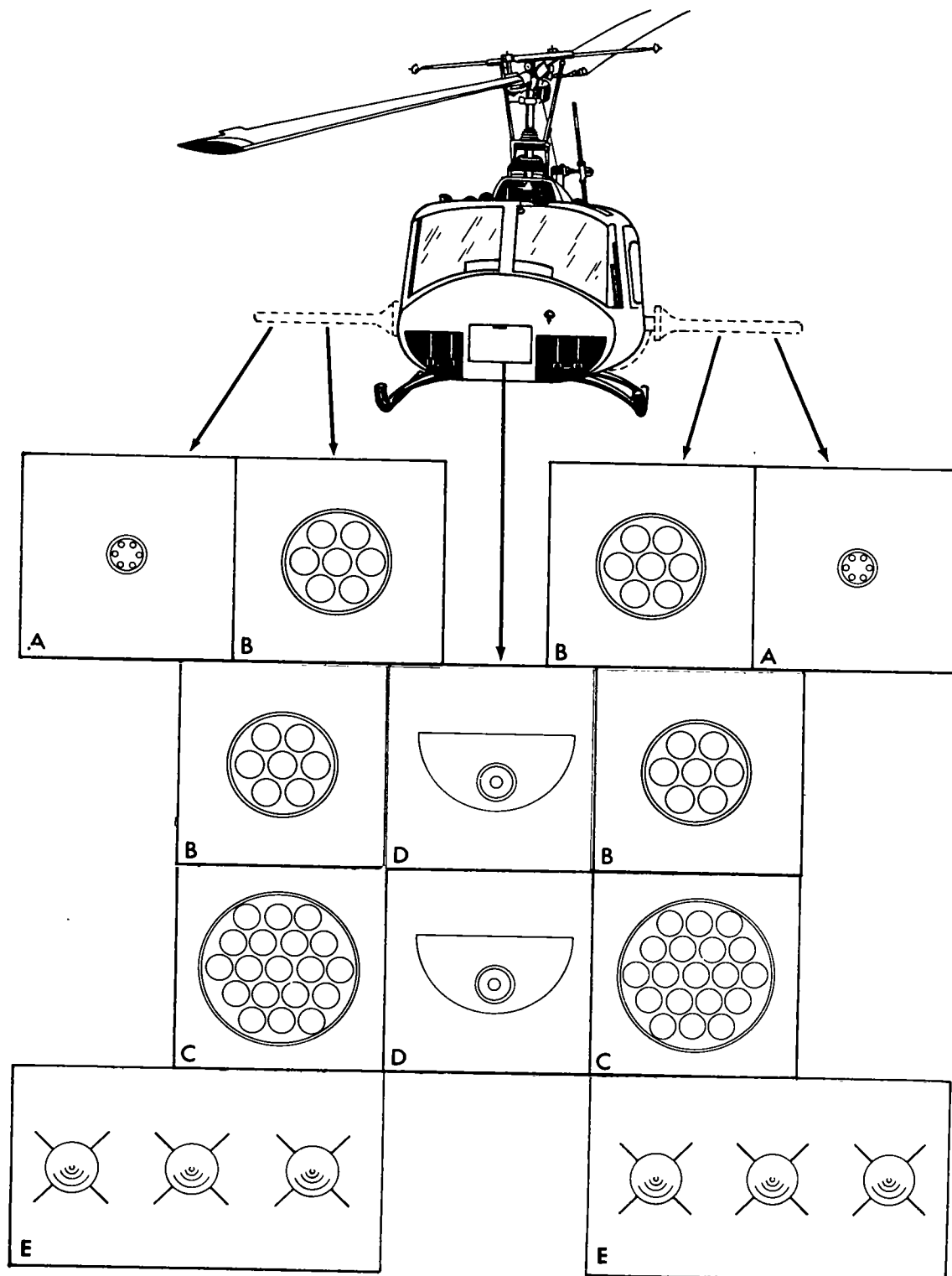
E M28A1 SUBSYSTEM: TWO 7.62MM HIGH RATE AUTOMATIC GUNS.

F M18A1: ARMAMENT POD, 7.62MM HIGH RATE AUTOMATIC GUN.

G XM120 SUBSYSTEM: XM140 30MM AUTOMATIC GUN.

H M35 SUBSYSTEM: 20MM HIGH RATE AUTOMATIC GUN.

Figure C-1. AH-1G armament configurations.



- A** M134: 7.62MM, HIGH RATE AUTOMATIC GUN.
B M158A1: SEVEN-TUBE, 2.75-INCH ROCKET LAUNCHER.
C M200A1: 19-TUBE, 2.75-INCH ROCKET LAUNCHER.
D M5 SUBSYSTEM: 40MM GRENADE LAUNCHER.
E M22 SUBSYSTEM: WIRE-GUIDED MISSILE.

Figure C-2. UH-1B/C/M armament configurations.

Table C-1. AH-1G Armament Subsystem Performance Data^a

Item	M28A1 ^b		M18A1	M85	M168A1	M200A1
<i>Ammunition type</i>	7.62mm	40mm ^c	7.62mm	20mm	2.75-in. ^c	2.75-in. ^c
<i>Ammunition capacity (rounds)</i>	4,000	300	1,500	1,000	7	19
<i>Range (meters):</i>						
Maximum.....	8,200	2,000	8,200	3,750	9,800	9,800
Effective.....	1,000	1,200	1,000	8,000	2,500	2,500
Minimum.....	100	300	100	300	300	300
<i>Rate of fire:</i>						
Shots per minute (guns).....	2,000/4,000	400	2,000/4,000	750		
Pairs per second (rockets).....					6	6
<i>Flexible limits:</i>						
Elevated.....	+20°	+20°				
Depressed.....	-50°	-50°				
Horizontal, right and left.....	110°	110°				
<i>Weight (lb):</i>						
Loaded.....	449	434	325	1,239	202	629
Unloaded.....	205	206	245	559	52	138

^a Due to classification, performance data for TOW guided missile armament subsystem has not been included.^b One M129 and one M184, two M129's, or two M184's.^c Burst radius—10 meters.

Table C-2. UH-1B/C/M Armament Subsystem Performance Data

Item	M5	M21	M22
<i>Ammunition type</i>	40mm ^a	7.62mm	2.75-in. ^{a,b}
<i>Ammunition capacity (rounds)</i>	300	6,400	14
<i>Range (meters):</i>			
Maximum.....	1,750	3,200	9,300
Effective.....	1,200	1,000	2,500
Minimum.....	300	100	300
<i>Rate of fire:</i>			
Shots per minute (guns).....	220	4,000/4,800	
Pairs per second (rockets).....			6
<i>Flexible limits:</i>			
Elevated.....	+15°	+10°	
Depressed.....	-35°	-85°	
Horizontal, outboard.....		70°	
Horizontal, inboard.....		12°	
Horizontal, right and left.....	60°		
<i>Weight (lb):</i>			
Loaded.....	335	1,346	682
Unloaded.....	233	674	249

^a Burst radius—10 meters.^b 2.75-inch rocket fires from fixed position.^c Wire-guided missile.

Table C-8. Attack Helicopter Flight Limitations

Helicopter designation	Limitation ^a				Ammunition capacity (rounds)			
	Gross weight (lb)	Fuel (lb)	Range (nautical miles)	Flight time on station (hr + min)	7.62mm	40mm	2.75-in. ^b	AGM-22B missiles
AH-1G-----	8,593	1,600	369	02+35	4,000	300	14	
	8,234	1,600	370	02+35	7,000	300		
	9,194	1,600	360	02+30	4,000	300	38	
	9,323	1,600	355	02+30	7,000	300	14	
	9,500	1,176	256	01+50	7,000	300	38	
	9,500	1,418	305	02+10	4,000	300	52	
	9,500	914	196	01+25	6,000		76	
UH-1B-----	8,297	1,000	166	01+45	6,000		14	
	8,380	1,000	166	01+45			48	
	7,974	1,000	185	01+50		150	14	
	7,548	1,000	190	01+54		315		
	8,308	1,000	166	01+45			38	
	7,766	1,000	176	01+45				6
UH-1C/M-----	8,500	900	163	01+28	6,000		14	
	8,500	816	145	01+20			48	
	7,878	1,000	189	01+40		150	14	
	7,852	1,000	189	01+40		135		
	8,500	900	163	01+28			38	
	8,070	1,000	187	01+40				6

^a Ranges and station times are based on standard day 2,000-foot pressure altitude using cruise power chart in applicable TM 55-series-10. Runup, climb, and reserve fuel not considered in computations.

^b Computed with MK 151 warheads on 2.75-inch rockets.

Section III. CARE AND HANDLING OF AMMUNITION

C-12. General

Training support personnel in the care and handling of ammunition should be a continuous process at unit level. All ammunition storage, handling, and basic safety procedures should be in accordance with TM 9-1300-206, TM 9-1305-200, TM 9-1340-201, unit SOP, and applicable AR. For ammunition characteristics, see TM 9-1300-200 and 9-1340-201.

C-13. 20mm, 30mm, 40mm, and 7.62mm Ammunition

a. Storage.

(1) Ammunition should be stored in specified areas. Whenever possible, munitions should be stored in the original containers until ready for firing.

(2) Oldest ammunition should be expended first to prevent a buildup of old ammunition which is more subject to deterioration.

b. *Handling and Safety.* Unit SOP will dictate specific safety procedures to be followed locally. Munitions must not be handled roughly or dropped.

c. *Loading.* All loading and unloading proce-

dures will be conducted according to the specific technical manual instructions on the individual weapons systems.

C-14. 2.75-Inch FFAR Ammunition

a. *Storage.* At present, 2.75-inch FFAR are packed in wooden boxes containing either 4 or 25 completely assembled rockets in fibre containers. Future packing methods will take advantage of advances in packaging techniques and materials. Rockets should be stored in their fibre containers until ready for firing. Storage areas should be dry, bunkered, and maintained within the temperature limits of -65° Fahrenheit to 150° Fahrenheit (as stenciled on containers).

(1) If the ammunition must be stored in an open area, adequate dunnage and cover should be provided. Care must be taken to provide for adequate ventilation around stack. For proper procedures, refer to TM 9-1300-206.

(2) If sockets are prepared for firing but are not fired, they should be resafetied and returned to their original fibre container or other suitable short term storage area. Rockets should be stored pointed toward the area that poses the least hazard to personnel and equipment.

b. Handling. When possible, rockets should be handled while in the fibre container. In any event, rockets must not be thrown, rolled, dragged, or handled roughly in any manner. If the motors are handled roughly, the propellant is likely to crack causing hazardous conditions when fired. Any evidence of rough handling is cause for rejection. (Cracking occurs more frequently at temperatures below 40° Fahrenheit.) Prior to loading, rockets should be kept free of sand, ice, snow, mud, grease, and other foreign matter.

c. Assembly. If field assembly of motors and/or fuzes is necessary, a torque wrench should be used to apply 55 (± 5) foot pounds of torque to the warhead and/or fuze.

Warning: Do not remove the grounding wire from the aft end of the rocket motor until ready to load the rocket into a launcher.

d. Loading and Unloading. Loading and unloading is accomplished in accordance with AR 385-63.

(1) Weapons switches OFF and weapons circuit breaker OUT.

(2) Ground helicopter.

(3) Make stray voltage check.

C-15. Guided Missiles

a. Storage. Guided missile ammunition requires no maintenance at the user level. Stacks will be limited to five rounds.

b. Handling. Guided missile ammunition should be handled only by trained personnel. Rough handling can cause ammunition malfunction, to include propellant explosion when ignited. For detailed handling instructions, see appropriate 9-series TM (app A).

c. Safety. Personnel engaged in handling, assembling, and loading of guided missile ammunition will observe the following precautions:

(1) The flightcrew must remove all rings and jewelry from their hands before assembling, installing, or disassembling missiles.

(2) Missiles will not be installed on the helicopter until the daily operational checks have been successfully completed.

(3) Missiles will not be mounted until the helicopter has been fueled, checked out, and is ready for flight.

(4) To approach or move away from missiles, personnel should move at a right angle to the line of fire.

(5) All persons not actively engaged in installing the missiles will remain at least 100 meters from the launchers and clear of the flight-path.

(6) The helicopter should be in an open area and positioned so that the missiles are pointing toward a safe, uninhabited area.

(7) Missiles should be mounted from the inside launcher to the outside, both left and right.

(8) Until just before helicopter takeoff, the explosive bolt cables will be connected to their shorting plugs.

(9) Never assemble missiles within 300 meters of a radio or radar installation that has more than 100 kilowatts of peak power.

d. Assembly, Loading, Unloading, and Disassembly. Only qualified personnel will assemble, load, unload, and disassemble guided missile ammunition. For assembly, loading, unloading, and detailed disassembly instructions, see appropriate 9-series TM (app A).



APPENDIX D

AEROMEDICAL ASPECTS OF HELICOPTER GUNNERY

D-1. Introduction

To insure optimum safety and effectiveness during helicopter gunnery operations, the aviator must be able to adapt to a modified environment with respect to changing barometric pressure, high and low magnitude G forces, vibration, and lighting conditions. Since our bodies have not been equipped with airworthy sensors in many respects, the aviator must constantly cope with erroneous perceptual information and the complex tasks of flight, navigation, communication, command, and target acquisition for successful completion of his mission.

D-2. Perception of the External Environment

Man is equipped with three sensory systems to provide him with information for spatial orientation—*visual*, *vestibular*, and *proprioceptive* systems. Information from all three receptor systems is integrated in the brain to maintain spatial orientation. Since the vestibular and proprioceptive systems are not suited to function well in the aviation environment, the aviator is constantly faced with the threat of spatial disorientation. When the flightpath is irregular during gunnery operation, the motion perceived by the sense organs may be erroneous and therefore lead to spatial disorientation. For details on sensory illusions, see TM 1-215.

D-3. Function of the Eye

Light gathered by the eye, like a camera, is projected in image form onto a light-sensitive surface. The light-sensitive surface of the eye, or retina, may be considered as having two sensory components—the *cones* and the *rods*.

a. The cones are provided for the perception of color; and our ability to see clearly, sharply, and precisely is known as acuity. The cones are concentrated in the center of the retina, the area where the image is formed when an object is viewed directly. For this reason, our central vision is most acute. The cone cells function only under daytime levels of illumination. At dawn or dusk or as darkness approaches, color vision becomes less reliable and finally disappears. Only

during daylight hours can we depend upon the added dimension of color to characterize what we see. For this reason, gunship pilots should characterize targets by form or silhouette for acquisition under reduced lighting conditions.

b. The rods are located throughout the retina except in the central portion. They do not respond as precisely as the cones; therefore, our peripheral vision is much less precise than central vision. The rods do not differentially respond to colors, they see only shades of gray and silhouettes. They are, however, capable of extreme sensitivity and are responsible for nighttime vision. Vision under reduced lighting conditions is colorless, limited to peripheral vision (due to the central blind area with lack of cone function), and to silhouette form. As one might expect, visual illusions are common when levels of light are diminished.

D-4. Night Vision

a. Night vision is dependent upon optimum function and sensitivity of the rods of the retina. Lack of oxygen to the rods (hypoxia) significantly reduces their sensitivity to reduced lighting. Without supplemental oxygen, a measurable decline in night vision is evident at pressure altitudes of as low as 5,000 feet. For this reason, target acquisition under nighttime conditions in mountainous terrain could be more difficult without supplemental oxygen. Agents such as carbon monoxide reduce the blood's capacity to carry oxygen and thus increase man's "physiological altitude." Smoking of cigarettes is a significant source of carbon monoxide which reduces night visual sensitivity still further. Also, medications like some of the sulfa drugs or APC's can reduce the blood's capacity for oxygen carriage by modification of hemoglobin (the oxygen carrying component in red blood cells).

b. Under subdued lighting conditions, dark adaptation for optimum night visual sensitivity approaches completion in approximately 30 minutes. Visual purple is the substance of the rods responsible for light sensitivity; dark adaptation occurs with increased levels of this substance in the rods.

Maintenance of dark adaptation is dependent upon continued absence of bright light which can rapidly destroy the increased levels of visual purple necessary for increased sensitivity of the rods for nighttime viewing. Exposure to intense light (as bright sunlight) a few hours prior to nighttime viewing can also reduce the final degree of dark adaptation possible. In order to acquire and maintain optimum levels of dark adaptation and visual function during nighttime operations, the following should be observed:

(1) Wear dark glasses if planning to venture into the sunlight on the afternoon prior to a night mission.

(2) Use minimum essential instrument and/or cockpit lighting during night operations.

(3) Use ruby red illumination in the aircraft and red lens covers over flashlights to help preserve dark adaptation. However, remember that red illumination will obscure red and other colored references essential for interpretation of maps, etc.

(4) Avoid looking at bright lights or light reflected from the windscreen, clouds, and fog; especially when landing lights and/or searchlights are used.

(5) Use landing and searchlights only when necessary, with full realization that if they are extinguished virtual blindness will result.

(6) Avoid looking at flares, minigun flash, and other bright fire while on night operations. Only one member of the crew should confirm hits at night, preferably the gunner.

(7) When exposure to bright light is probable, one crewmember should (when possible) direct his eyes within the cockpit and/or close one eye to prevent loss of dark adaptation, and be prepared to recover the aircraft if his fellow pilot is momentarily blinded.

(8) For safe and effective gunship operations, instrument proficiency and recovery must be stressed due to the possibility of flash blindness from flares, miniguns, and other intense light sources. Flash blindness can occur during daylight hours from intense light of nuclear devices. If flash blindness occurs at night, instrument lighting should be turned full bright and recovery made on instruments.

(9) Decreased visual acuity and the presence of a physiological night blindspot is evident with subdued lighting. To acquire targets and other objects, it is necessary to continually scan rather than using direct gaze useful only during daylight viewing.

D-5. Target Fixation or Fascination in Flying

This illusory phenomenon occurs when a pilot, for one reason or another, ignores orientation clues by focusing his attention on single objects or targets. Target hypnosis is a common type of fascination which occurs when pilots become so intent upon hitting their targets that pullup from the flightpath of engagement is delayed. This illusion is minimized in dual-controlled gunship aircraft. The gunner's tendency to target fixation is overcome by a pilot whose primary job is to stay with the aircraft. The pilot should fly the aircraft flight envelope for a given target, not the target itself.

D-6. Avoidance of Spatial Disorientation

The probability for the helicopter gunship pilot to become spatially disoriented is great due to the need for flight under obscured conditions, in a nap-of-the-earth profile, and during tactical maneuvers. To fly safely and in trim during gunnery procedures, he must maintain constant spatial orientation during flight. Specific areas for consideration are—

a. Helicopter gunnery pilots must make every attempt to understand the illusions of flight. Instrument proficiency and recovery must be maintained to avoid or survive spatial disorientation. (their natural or artificial) should be avoided.

b. Flight without visual reference points requires maintenance of dark adaptation is necessary for VFR night operations. Proper dark adaptation increases the number of visual references during nighttime viewing conditions.

c. Head movements during target acquisition and following should be minimized to prevent excessive vestibular stimulation. Movement should be confined to eye movements only when angular accelerations are imposed.

d. Rapid changing from VFR to IFR flight and vice versa should be minimized.

e. Avoidance of the "self-imposed" stresses is of paramount importance.

(1) Fatigue and anxiety tend to decrease attentiveness and render an individual more susceptible to the effects of the illusions of flight.

(2) Smoking is an important source of carbon monoxide. Carbon monoxide decreases the blood's capacity for oxygen carriage. Reduced oxygen-carrying capacity means increased physiological altitudes of the body and hence earlier loss of dark adaptation with altitude.

(3) The toxic partial breakdown products of

alcohol (responsible for a hangover) are irritating to the vestibular system. The vestibular illusion of flight is therefore increased with a hangover, thus increasing the possibility for spatial disorientation.

(4) Hypoglycemia (low blood sugar) should be avoided. A common cause of hypoglycemia is

"rebound" following a carbohydrate meal consisting of a sweet roll or coke.

(5) Self-medication should be avoided. Many agents sold over the counter, such as the common cold tablet, can greatly increase the chances for spatial disorientation during flight.



APPENDIX E

SAMPLE GUNNERY CHECKLISTS AND CREW DUTIES

Note. The sample checklists included herein may be modified to meet individual unit requirements.

E-1. Permission Coordination Checklist

(To be used for coordination between the supported ground unit and the attack helicopter force.)

a. Situation.

- (1) Unit being supported.
- (2) Coordinating personnel.
 - (a) Supported.
 - (b) Others.
- (3) Supporting fires in area.
 - (a) Mortars/artillery.
 - (b) Naval gunfire.
 - (c) Tactical air.
- (4) Enemy estimated in area.
 - (a) Strength and disposition.
 - (b) Weapons and capabilities.
- (5) Tactical air support plan.

b. Mission.

- (1) Date and time of operation.
- (2) Location of operation.

c. Execution.

- (1) Concept of operation.
- (2) Task of subordinate elements.
- (3) Task of attached elements.
- (4) Coordinating instructions.
 - (a) Formations.
 - (b) Routes.
 - (c) Altitudes.
 - (d) Starting and takeoff time.

d. Administration and Logistics.

- (1) Escape and evasion.
- (2) POL, ammunition, rations.
- (3) Medical evacuation.
- (4) Recovery instructions for downed aircraft.
- (5) Maintenance and armament support.

e. Command and Signal.

- (1) Frequencies and call signs.
- (2) Alternate means of communications.

- (3) Chain of command.

- (4) Command post and commander's location.

f. Special Instructions.

- (1) Ground security forces for servicing area.
- (2) Defense plans for refuel area.

E-2. Mission Planning Checklist

a. Operational time schedule.

- ##### b. Staging area (location and parking plan, if necessary).

c. Weather.

d. En route altitudes.

- ##### e. Approach and take off directions in landing zone.

f. Airspeed en route.

g. Flight routes.

h. Flight formations.

i. Use of phase lines and checkpoints.

j. Prestrike requirements.

k. Radar and IR warning procedures.

- (1) Scatter word.
- (2) Evasive maneuvers.
- (3) Reassembly coordination.

- ##### l. Electronic countermeasures procedures (e.g., onboard jammers, chaff, IR flares, etc.).

- ##### m. Areas of suspected targets (priority); e.g., antiaircraft areas in route of flight.

n. Target designation procedures.

o. Emergency procedures for downed aircraft.

p. Medical evacuation procedures.

q. Use of USAF support and/or artillery.

r. Observers.

s. Class III support.

- (1) Type refueling procedures.
- (2) Proposed refueling time.

- t. Radio frequencies and call signs.
- u. Class V support.
 - (1) Ammunition prestocked.
 - (2) Ammunition to be delivered.

E-3. Mission Checklist

a. Premission.

- (1) Crews alerted.
- (2) Crews briefed.
- (3) Readiness of aircraft and equipment.
- (4) Preflight and runup.
 - (a) Aircraft.
 - (b) Radio.
 - (c) Radar/IR warning.
 - (d) ECM.
 - (e) Armament.
- (5) En route formation (to staging area).
- (6) Radio discipline.
- (7) Parking (in staging area).
- (8) Logistics.
 - (a) Classes I, III (A), V (A).
 - (b) Special equipment.
 - 1. Survival.
 - 2. Maintenance.
 - (c) Support equipment.
- (9) Final briefing on tactical situation.

b. During Mission.

- (1) Supervision of—
 - (a) Tactical formations.
 - (b) Escort procedures.
 - (c) Reconnaissance.
 - (d) Evasive maneuvers.
 - (e) Reassembly procedures.
 - (f) Radio procedures.
 - (g) Reports (Code and SOI, etc.).
- (2) Evaluation of—
 - (a) Battle damage and possible repair.
 - (b) Collection and dissemination of latest enemy intelligence.
 - (c) Redistribution of personnel and equipment.
 - (d) Reports to and from checkpoint.
 - (e) Preparation for next lift or strike.
 - (f) Additional resupply when required.

c. Postmission.

- (1) Operational status—damage assessment.
- (2) Resupply.
- (3) Debriefing.
 - (a) Intelligence.
 - (b) Operational.
 - 1. Unit and individual performance.
 - 2. Lessons learned.

(4) Postflight and maintenance.

- (a) Aircraft.
- (b) Weapons.

E-4. Debriefing Checklist

a. Estimate of mission results (degree to which mission was accomplished).

b. Enemy activity encountered or observed during mission. Report in following sequence:

(1) *Line A*—WHO made the sighting or observation (aircraft number, mission number, patrol, etc.).

(2) *Line B*. WHAT was observed (enemy, unknown, or friendly forces; radar and IR warning indication; strength and type of target—tanks, infantry, patrol, bivouac area; include number of items observed and what they were doing—halted, digging in, moving (if moving, include directions of movement)).

(3) *Line C*—WHERE the activity was sighted (universal transverse mercator (grid) (UTM) coordinates or cardinal point from geographic location in the clear if the report is of enemy activity) and WHEN (time sighted and/or reported). Relative bearing and intensity of displayed radar or IR warning indication; aircraft location, heading, and altitude during threat reception.

(4) *Line D*—WHERE spot (hot) reports were made and to whom (if applicable).

(5) *Line E*—DAMAGE reports (if applicable).

c. Debrief individual flightcrews.

- (1) Aircraft hits.
- (2) Radar/IR warning and en route fire received.
- (3) Targets engaged.
- (4) Estimated killed in action (KIA).
- (5) Estimated wounded in action (WIA).
- (6) Ammunition expended.
 - (a) 2.75-inch FFAR.
 - (b) 7.62mm.
 - (c) 40mm.
 - (d) M22 ATGM.
 - (e) Small arms.
 - (f) .50 caliber.
- (7) Weapons status.
- (8) Radar/IR warning receiver and ECM equipment status.

d. Estimate of aviation portion of mission.

(1) Conduct of operation in the PZ: As planned? Problems:

(2) Flight route and checkpoints: Adequate? Easily identified?

(3) Formation and altitude: Most suitable?

(4) Evasive maneuvers and reassembly: As planned? Effective?

(5) Radar/IR warning indication used for target engagement: Procedures for using radar/IR warning indicators? Will these procedures be effective?

(6) Activity in the landing zone (LZ): As planned? Alternate?

(7) Communications: Adequate? Excessive?

(a) Air-to-air.

(b) Air-to-ground.

(c) SOI-SSI.

e. Aircraft damage and personnel casualties KIA and WIA.

(1) Personnel casualties.

(2) Aircraft damage. What? When? Where? How?

f. Refueling and maintenance problems.

g. Mission command.

(1) Was the concept of the operation carried out as planned?

(a) Flight routes.

(b) Flight altitudes.

(c) Flight formation.

(d) Time schedules.

(e) Communications.

(f) Other.

(2) Were the enemy and friendly situations valid as received at the briefing?

(3) Were there any delays or confusion which could have been eliminated?

(4) Lessons learned.

(a) Ground units.

(b) Aviation units.

(5) Actions taken for correction.

E-5. Duties of Aircraft Commander

a. Briefs entire crew on—

(1) Mission.

(2) Friendly and enemy situation.

(3) Restrictions to fire.

(4) Weather.

(5) All other available information pertaining to the mission.

b. Commands aircraft, regardless of who is at controls.

c. Makes radio check per unit SOP.

d. Makes radar/IR warning receiver check.

e. Makes ECM equipment check.

f. Monitors radar/IR warning receivers and directs employment of onboard ECM.

g. To keep aircraft within gross weight limitations, determines that only mission-essential equipment is aboard and operational.

h. Is responsible during mission for actions of all crewmembers.

i. Personally supervises rearming and refueling of aircraft. If he must be absent, directs that the copilot supervise and/or assist in rearming and refueling.

j. Keeps sharp lookout for other aircraft.

k. Debriefs crew after mission.

l. Trains the crew in unit procedures applicable to the area of operation.

m. If aircraft commander of lead ship, personally completes mission reports for his flight.

E-6. Duties of Pilot

a. Obtains necessary equipment from unit operations.

b. Preflights aircraft and armament system.

c. Insures that all required equipment, to include protective and survival equipment, is aboard and operational.

d. Tunes radios and makes frequency changes as directed by aircraft commander.

e. Monitors all radio frequencies not being monitored by aircraft commander.

f. Assists aircraft commander in monitoring radar/IR warning receivers, placing priority on threat indications from relative bearings best covered by the pilot.

g. Operates or employs ECM as directed by the aircraft commander.

h. Records all pertinent information received on radio and from other crewmembers that has bearing on mission.

i. Records coordinates and times of all strikes and areas from which fire is received.

j. Arms and de-arms armament subsystem.

k. Monitors aircraft instruments during flight and notifies aircraft commander when fuel remaining is 400 pounds.

l. Assists with rearming and refueling.

m. Clears aircraft for turns to the left.

n. Assists aircraft commander as directed by aircraft commander.

o. Keeps crew chief and gunner up to date on tactical situation.

p. Keeps sharp lookout for other aircraft.

q. Checks SOI for familiarity with necessary call signs and posts schedule code for quick use.

r. Navigates and maintains general aircraft location on the map at all times.

E-7. Duties of Crew Chief (UH-1)

a. Completes daily inspection prior to arrival of pilot for preflight.

b. Insures standard loading of weapons, ammunition, and survival equipment.

c. Informs pilot as to condition of helicopter and any special characteristics or deficiencies in helicopter.

d. Assists aircraft commander in adjusting seat and closes door, unless directed otherwise.

e. Arms the M5 subsystem and the weapons system on right side of helicopter.

f. Clears helicopter in parking area and for turns to right while in flight.

g. Employs ECM (dispenses IR flares, chaff, etc.) as directed; or if missile is sighted, calls out "Missile right!" (left, rear).

h. Throws smoke grenade and calls "Fire" when fire is received.

i. Lays down protective fire while helicopter disengages. Fires under disengaging helicopter on all breaks and under the trailing helicopter after 180° breaks.

j. Monitors fire mission commands and insures that he has sufficient ammunition to provide fire if required.

k. Keeps pilot informed as to armament status and amount of ammunition remaining.

l. Refuels helicopter.

m. Rearms helicopter with assistance of pilot and door gunner.

n. Reloads ECM expendable materials with assistance of pilot and door gunner.

o. Maintains accurate records on helicopter and armament.

p. Repairs and maintains helicopter as authorized.

q. Supervises and assists door gunner in cleaning and reassembling machinegun if time permits.

r. Supervises training of door gunner.

s. Knows emergency medical care procedures.

t. Insures that rations and water are aboard helicopter.

u. Keeps sharp lookout for other aircraft from 6 o'clock position to 1 o'clock position.

v. Informs pilot of any movement on the ground in mission area.

w. Acknowledges all instructions from pilot and aircraft commander.

E-8. Duties of Door Gunner (Utility and Cargo Helicopters Only)

a. Draws required weapons and equipment and places them on the helicopter.

b. Insures that reserve ammunition is aboard in bandoliers or assault packs as required by loading SOP.

c. Assists pilot with preflight.

d. Assists crew chief with daily inspection.

e. Assists pilot with adjusting seat and closes door, unless directed otherwise.

f. Clears helicopter on left side in parking area and for turns to left while in flight.

g. Employs ECM (dispenses IR flares, chaff, etc.) as directed; or if missile is sighted, calls out "Missile, left!" (right, rear).

h. Keeps sharp lookout for other aircraft from 6 o'clock position to 11 o'clock position.

i. Arms weapons system on left side of helicopter.

j. Monitors fire mission commands and insures that he has sufficient ammunition to provide fire on break if required.

k. Throws smoke grenade and calls "Fire" when fire is received.

l. Lays down protective fire while helicopter disengages. Fires under disengaging helicopter on all breaks and under the trailing helicopter after 180° breaks.

m. Assists pilot and crew chief in rearming and refueling helicopter.

n. Assists pilot and crew chief in replenishing expendable ECM material.

o. Cleans rifle and machineguns with assistance of crew chief.

p. Informs pilot of any movement in the mission area which has not been previously observed.

q. Knows first aid procedures and how to administer morphine.

r. Acknowledges all instructions by pilot and aircraft commander.

s. Insures that all weapons aboard helicopter are cleared at end of flight.

t. Assists crew chief in maintenance of helicopter if time permits.

E-9. Individual Survival Kit, Crewmember

a. Listed below are the minimum required items of survival equipment to be placed in the standard combat pack issued to each individual.

- (1) Two-part emergency survival kit.
- (2) Signal mirror.
- (3) Hand-held mayday flares.
- (4) Multilingual request for assistance.
- (5) Snakebite kit.
- (6) Insect repellent.
- (7) Matches.
- (8) Pocket knife.
- (9) Survival compass.
- (10) Flashlight.

b. Minimum survival items required to be secured to the individual crewmember's webbelt are—

- (1) Canteen with fresh water.
- (2) Survival pack.
- (3) Machete knife or jungle axe.
- (4) First aid packet.
- (5) Individual weapon if applicable.

E-10. Required Items of Uniform

The items of clothing and equipment listed below will be worn by air crewmembers during aerial flight.

- a.* Fire retardant clothing with sleeves rolled down.
- b.* Combat boots.
- c.* Flak vest with survival knife affixed to left side (optional).
- d.* Chest protector.
- e.* Groin protector (optional).
- f.* SPH-4 helmet w/clear visor.
- g.* Flying gloves (gauntlet type).
- h.* Sun glasses (optional).
- i.* Identification tags with chain.
- j.* Protective mask.

E-11. Sample Format Checklist for Spot, Site, and Pilot Reports (PIREP)

(Use format by reading down under each type report. Use only those items which apply.)

Time received		Control No.	
	SPOT	SITE	PIREP
ALPHA:	OBSERVER	OBSERVER	OBSERVER
BRAVO:	WHAT (enemy)	WHAT (LZ, PZ)	WHAT (Visibility (WEA))
CHARLIE:	WHERE (Coordinates-clear)	WHERE (Coordinates-encode)	WHERE (Coordinates-encode)
DELTA: (Convoy, Troops Moving)	ACTIVITY	SIZE (plt, co)	ACTIVITY (Stationary, T)
ECHO:	YOUR ACTION (contact)	BEST NO WIND LDG DIRECTION.	WIND DIRECTION
REMARKS:			



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By Order of the Secretary of the Army:

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